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Energy Research Abstracts

Abstracts 13934–16031

Office of Scientific and Technical Information
UNITED STATES DEPARTMENT OF ENERGY

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Energy Research Abstracts

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Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports and patent applications originated by the U.S. Department of Energy, its laboratories, energy centers, and contractors, as well as theses and conference papers and proceedings issued by these organizations in report form. Audiovisual materials, computer media (magnetic tapes, diskettes, etc.), and engineering drawings are included in this definition. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations, *provided* that the full text of the document has been received by OSTI. Foreign report information is obtained through the International Energy Agency's 14-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. The purpose of this publication is to announce documents produced or obtained by DOE that are not so readily available as journal articles, books, or patents. Please note that beginning with the January 1991 issue, *ERA* does not cover nonreport literature.

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The scope of *ERA* encompasses DOE's research, development, demonstration, and technology programs resulting from its broad charter for energy sources, supplies, safety, environmental impacts, and regulation.

The citations presented in *ERA* are available for online searching as records within the Energy Science and Technology Database (EDB). The current-year records are available on the Integrated Technical Information System (ITIS).

Availability

DOE and DOE contractors who have OSTI deposit accounts can obtain *ERA* (regular issues and annual indexes) from the Office of Scientific and Technical Information, P.O. Box 62, Oak Ridge, TN 37831, Attention: Information Services. For further information, call (615)576-8401, FTS 626-8401. *ERA* is also available at authorized GPO Depository Libraries. (List is provided on the inside back cover.)

ERA (regular issues and annual indexes) is available to the public on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Managing Editor, Doris M. Henline
Technical Editor, Robert W. Rutkowski

Information Sources

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- Canada
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- France
- Federal Republic of Germany
- Italy
- Japan
- The Netherlands
- Norway
- Spain
- Sweden
- Switzerland
- United Kingdom
- United States

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The principal data elements included in these citations are:

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2. **Report number** identification for report-type literature.
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4. **Author(s).** First 10 names in the data record are printed, then "et al." is listed.
5. **Author affiliation.** Only first one is listed, in parentheses after author(s) to which it applies.
6. **Collaboration,** if present.
7. **Corporate author(s)** identifying corporation responsible for document.
8. **Date of publication.** If not known, a processing date is in brackets.
9. **Number of pages** or page range. Prices are based on total pages unless special pricing applies.
10. **Language** of document if non-English.
11. **Monograph title** if citation is an analytic (part, chapter, or paper) of a larger monograph.
12. **Sponsoring organization.**
13. **Contract or grant number.**
14. **Secondary identifying number;** may be a conference number.
15. **Conference title, location, and date,** if applicable.
16. **Order number.** The "DE" order number may be used for ordering from NTIS or OSTI, as appropriate. The "TI" prefix is valid only at OSTI.
17. **Sources of availability** from which a copy of the document may be obtained; usually appear as abbreviations. (See information on following page.)
18. **Drop note** or explanatory statement.
19. **Abstract.**
20. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. Wisconsin Univ., Madison (USA). Dept. of Physics. [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

54 (DOE/ER/60888-1-Vol.1, pp. 115-117) **Investigation of air pollution in house due to use of various fuels.** Luo, Dayu (Chengdu Sanitation (China)). Canada Mortgage and Housing Corp., Ottawa, ON (Canada). 1990. (CONF-900724-Vol.1: Indoor Air '90: 5th international conference on indoor air quality and climate, Toronto (Canada), 29 Jul - 3 aug 1990). In Indoor air '90: The fifth international conference on indoor air quality and climate. Volume 1: Final report. 786p. Order Number DE90017786. Source: NTIS.

Air pollution in houses caused by combustion of coal is more serious than that by combustion of natural gas and methane (primarily by SO_2 and NO_2). The gas concentration after cooking is higher than that before cooking, and it is higher in kitchen than in bedroom and outdoor. There were mutations in the extract from TSP in 30m^2 air in the bedroom, kitchen and outdoor, where coal and natural gas were used. The supernatant saliva activity of children whose family uses coal is significantly lower than that of pumping streams.

How To Order from the Availability Sources

TO OBTAIN A REPORT

Report literature, usually identified by an alphanumeric identifier at the beginning of a citation, is available from the sources listed in the citation (see example of element 2 on page iii). Often the sources are listed as abbreviations. Corresponding addresses are provided at right from which documents with these abbreviations may be ordered. When "OSTI" is given, **DOE and DOE contractors may order these documents from OSTI.** (However, check with your library or information organization which may require that orders go through them to OSTI.) OSTI prices are based on total pages unless special pricing applies. The public should order from NTIS or from one of the other agencies listed in the citation. NTIS price codes may continue to appear in some records. To expedite processing, an order form is provided in the back of this publication. NOTE: The order numbers provide quicker access for report ordering. Use the order number where possible.

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INIS *Available only in microfiche.*
INIS Clearinghouse
International Atomic Energy Agency
P.O. Box 100, A-1400
Vienna, Austria

NTIS U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

OSTI U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

How To Use the Indexes

Five indexes are provided for approaching the content of each issue of *Energy Research Abstracts*. Descriptions of entries in these indexes follow.

Corporate Author Index
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 15:18255 (R;US)

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 15:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 15:18494 (R;US)

Subject Index
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

HYDROGEN ISOTOPES
See also DEUTERIUM
HYDROGEN 4
TRITIUM
Neutron-Rich Isotopes
Study on the strong neutron-rich nuclei of lightest elements, 15:18686 (RA;SU;In Russian)

Contract Number Index
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
15:18494 DOE/ER/40438–T1
FG02-88ER60664 **Rogers and Associates Engineering Corp., Salt Lake City, UT (USA)**

Report Number Index
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

DOE/ER/40438–
T1 15:18494 NTIS, OSTI E 1.99: DE89007246 MF-411

Subject Contents

The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the database records.* The following list includes all of the 39 first-level and the 308 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in DOE/TIC-4584, *Energy Data Base: Subject Categories and Scope*.

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Energy Research Abstracts

01 COAL, LIGNITE, AND PEAT

Refer also to citation(s) 14703

13934 (STEV-TORV–91-1) **Peat characterization: Progress report, stage 3, 1988-1990.** Albano, C. (Umeaa Univ., (Sweden). Centrum foer Torvforskning). Statens Energiverk, Stockholm (Sweden). 1991. 42p. (In Swedish). Project STEV-216-088. Order Number DE91763556. Source: OSTI; NTIS (US Sales Only).

This report summaries the third period (1988-1990) of a research project about fundamental studies of peat characterization. The actual report which covers the third period, 1988-1990, is written as a summary and we have chosen to refer to publications produced in the project for detailed reading. The project represents the restart of basic peat research in Sweden, and much of the work so far has served to re-establish fundamental peat knowhow. In doing so, traditional methods have been reviewed, but in addition some very recent methodological developments have been adopted. The experience gained while studying peat with these methods will also be useful in a wider context. The basic idea of the project has been to obtain a fairly 'complete' description of peat. The project has an integrated approach which means that several subprojects is done with participation from different parts of the project.

0103 Preparation

Refer also to citation(s) 14016, 14017, 14018, 14019, 14020, 14021, 14045, 14485, 14841

13935 (DOE/PC/79880–T2) **Sulfur and mineral matter reduction in coal using selective agglomeration: Second quarterly technical report for the period January 1, 1988–March 31, 1988.** Simmons, F.J., Keller, D.V. Jr. OTISCA Industries Ltd., Syracuse, NY (USA). Mar 1988. 24p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-87PC79880. Order Number DE91009896. Source: OSTI; NTIS; GPO Dep.

The major program objective is to evaluate the ability of selective agglomeration to reject pyrite as a function of raw coal handling, storage and aging. This quarter we collected three (3) samples each of four (4) raw coals using procedures which would insure that we would have fresh unoxidized samples available throughout the program. The raw coal samples stored under nitrogen are considered our baseline sample, and will be used to develop data for comparison as the program progresses. The raw coal samples stored under ambient atmosphere and mine site tap water will be processed at specific time intervals. Data obtained from these samples will be compared to the data obtained from equivalent processing of the nitrogen reference coal. By this procedure we will insure the availability of fresh raw coal samples for all phases of testing. We will also be able to closely monitor the aging of all four (4) coals from a known starting point with respect to the various handling and storage procedures used. 4 figs., 11 tabs.

13936 (DOE/PC/79880–T3) **Sulfur and mineral matter reduction in coal using selective agglomeration: Third quarterly technical report for the period April 1, 1988–June 30, 1988.** Simmons, F.J., Keller, D.Y. Jr. OTISCA Industries Ltd., Syracuse, NY (USA). Jun 1988. 102p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-87PC79880. Order Number DE91009897. Source: OSTI; NTIS; GPO Dep.

The major program objective is to evaluate the ability of selective agglomeration to reject pyrite as a function of raw coal handling, storage and aging. First, we collected three (3) samples each of four (4) raw coal using procedures which would ensure that we would have fresh unoxidized samples available throughout the program. The raw coal samples stored under nitrogen are considered our baseline sample, and will be used to develop data for comparison as the program progresses. The raw coal samples stored under ambient atmosphere and mine site tap water will be processed at specific time intervals. Data obtained from these samples will be compared to the data obtained from equivalent processing of the nitrogen reference coal. By this procedure we will ensure the availability of fresh raw coal samples for all phases of testing. We will also be able to closely monitor the aging of all four (4) coals from a known starting point with respect to the various handling and storage procedures used. Information on chemical composition, and coal surface analysis by electron spectroscopy and fourier transform infrared spectroscopy is presented.

13937 (DOE/PC/88883–T8) **Development of the Electroacoustic Dewatering (EAD) process for fine/ultrafine coal: Ninth quarterly progress report, period ending December 31, 1990.** Kim, B.C.; Criner, C.L.; Senapati, N.; Menton, R.; Chou, Y.L.; Chauhan, S.P. Battelle, Columbus, OH (USA). 25 Jan 1991. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-88PC88883. Order Number DE91008950. Source: OSTI; NTIS; GPO Dep.

Electroacoustic Dewatering (EAD) capitalizes on the adaptation of synergistic effects of electric and acoustic fields to commercial coal dewatering systems, such as belt filter presses. The Battelle project for demonstrating the potential for commercial application of the EAD process for coal has the following objectives: to validate the expected technical feasibility and energy conservation/economic benefits of the EAD process as applied to fine (-100 mesh) and ultrafine (-325 mesh) coal; and to obtain data from a continuous, process research unit (PRU) in order to conduct a reliable economic analysis and to design commercial EAD filters as well as to promote adaptation of the process by the coal preparation industry. During this quarter, efforts were directed towards completion of PRU operation. The paper describes results from field testing on miners 325 mesh Upper Freeport coal and discusses the effects of experimental factors on final cake solids and on delta solids and linear regression models. 4 figs., 4 tabs.

13938 (DOE/PC/88885–T2) **Proof of concept and performance optimization of high gravity batch type centrifuge for dewatering fine coal: Quarterly technical progress report No. 5 revised, September 21, 1990–December 20, 1990.** Smith, L.B.; Durney, T.E. Jr. Coal Technology Corp., Bristol, VA (USA). 28 Jan 1991. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-89PC88885. Order Number DE91009493. Source: OSTI; NTIS; GPO Dep.

The objectives of this project is to generate and record a data base with the prototype centrifuge and to use the data base to determine the appropriateness of the system for coal processing and to determine how the more vital systems can be balanced so that the centrifuge can achieve optimum performance. Task 2 included the upgrading and testing of both the hardware and software of the data logging system. It also included improving and testing the data transducers as well as those support hardware systems which were preventing the logging of the primary data in real time. The first sub-task in Task 3, consists of feasibility tests of the technology. In particular it is designed to demonstrate the ability of the non-blinding filter system to operate successfully over extended periods of time. The second subtask in Task 3, demonstrates the ability of the system to dry a variety of coals from various coal fields to satisfactory moisture levels. Task 3 has been completed. Task 4 is designed to optimize the operation and the interactions of the six most important systems in the new centrifugal dryers. The work plan schedule called for this task to begin at the completion of Task 3. However, during the testing in Tasks 2 and 3, it became evident that it would be necessary to perform some of the Task 4 optimization ahead of schedule. The earlier test work had uncovered serious problems with some of the systems scheduled to be optimized during Task 4, and so it was deemed to be appropriate to move ahead and address the problems earlier to enhance the value of Task 3. Results from the completed tasks as well as preliminary results from Task 4 are presented. 8 figs.

13939 (DOE/PC/89908–T6) **Engineering design and analysis of advanced physical fine coal cleaning technologies: Quarterly technical progress report No. 5, October–December 1990.** Aspen Technology, Inc., Cambridge, MA (USA). 20 Jan 1991. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-89PC89908. Order Number DE91008949. Source: OSTI; NTIS; GPO Dep.

The major goal is to provide the simulation tools for modeling both conventional and advanced coal cleaning technologies. This DOE project is part of a major research initiative by the Pittsburgh Energy Technology Center (PETC) aimed at advancing three advanced coal cleaning technologies- heavy-liquid cyclonig, selective agglomeration, and advanced froth flotation through the proof-of-concept (POC) level. The commercially available ASPEN PLUS process simulation package will be extended to handle coal cleaning applications. Algorithms for predicting the process performance, equipment size, and flowsheet economics of commercial coal cleaning devices and related ancillary equipment will be incorporated into the coal cleaning simulator. The technical status of the following subtasks is briefly described: Interpolation Routine; Gravity Separation Models; Dewatering Models; Classification Models; Froth Flotation; and ASPEN PLUS Implementations.

13940 (DOE/PC/89909–T4) **In-plant testing of microbubble column flotation: Technical progress report, fourth quarter, October 1, 1990–December 31, 1990.** Luttrell, G.H.; Mankosa, M.J.; Adel, G.T.; Yoon, R.H. Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (USA). Virginia Center for Coal and Energy Research. [1990]. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-89PC89909. Order Number DE91008362. Source: OSTI; NTIS; GPO Dep.

This report describes progress in two areas: advanced instrumentation and column installation. The project is working with both 30-inch and 8-foot columns for coal flotation. The paper describes installation of the instrument package, the control loops, and the data acquisition system. Under the second area of study, a test plan was developed for a parametric study of the 8-foot column operating conditions (feed flow rate, gas flow rate, wash water flow rate, and froth addition) that were determined to influence separation efficiency on the 30-inch column. Results to date are discussed. 7 refs., 4 tabs. (CK)

13941 (DOE/PC/90177–T1) **Evaluation, engineering and development of advanced cycloning processes: Quarterly technical progress report No. 1, September 27, 1990–December 31, 1990.** Coal Technology Corp., Bristol, VA (USA). [1990]. 19p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-90PC90177. Order Number DE91009485. Source: OSTI; NTIS; GPO Dep.

The projects goal is to develop an advanced coal beneficiation technology that can achieve high recovery of the parents coals calorific value, while maximizing pyritic sulfur removal. Coal cleaning is to be accomplished by physical means and incorporate an advanced form of cycloning, or multiple gravity process. Initially evaluation of different media types and their attendant recovery, concentration, and regeneration systems will be completed. This first phase involves a paper study and a number of laboratory tests to eliminate unfeasible options. The second phase involves detailed testing of the more promising media and separators in a closed loop circuit. The separatory devices under consideration include small diameter high pressure cyclones, a disk stack centrifuge, and a magnetically enhanced media separator. The third and final phase will consist of testing a 1,000 lb/hr open loop, bench-scale, plant designed with the optimum media, separator, and media recovery process based on earlier results. This first quarter was spent getting organized by preparing and submitting the required Project Work, QA/QC, Manpower, Cost and Schedule plans. The test coals were procured and a plan submitted for their characterization. Separating Media Evaluation Plan was also readied. Information on the test coals and a description of the project plans are given. 1 fig., 5 tabs.

13942 (DOE/PC/90178–T1) **Selective flotation of fossil resin from western coal: Quarterly report, August 1, 1990–November 30, 1990.** Jensen, G.F.; Miller, J.D. Utah Univ., Salt Lake City, UT (USA). 30 Nov 1990. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-90PC90178. Order Number DE91008522. Source: OSTI; NTIS; GPO Dep.

Technical activities involved efforts by both the University of Utah and Advanced Processing Technologies, Inc. Laboratory research at the University of Utah was concerned with surface chemistry/resin characterization density, proximate and ultimate analyses, molecular weight, magnetic susceptibilities, and hexane solubility and the development of analytical techniques. APT's activities included plant engineering, test plan formulation, as well as equipment procurement/construction. Results to date are given. 2 figs., 4 tabs.

13943 (ETDE/JP-mf–1759127, pp. 69-74) **On the history of coal preparation technology in Japan.** Onodera, J. (The Coal Mining Research Center, Tokyo (Japan)). Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper described the outline of Japanese coal preparation technology. Six coal preparation plants of 5 large companies are operating, which are processing raw coal of 11 million tons per year and producing commercial coal of 9 million tons per year. One plant carries out the dry screening and remaining plants carry out the wet screening by jig drives. Three plants have the heavy media vessels and one plant has the heavy media cyclone. One plant carries out the spiral screening. As the typical process, oversize of raw coal is screened on a screen net by the Drewboy heavy media vessels and the undersize is screened by the Baum jig or the heavy media cyclone. Fine coal of 0.5mm or less is recovered by the froth floatation or the spiral floatation. Debris particles are abandaned. As new techniques, an air pulsated jig of undersize air chammber type which has features of small wave nonuniformity of vibrating water and small phase lag; or the Sevonett floatation machine of large processing capacity, are used. A highly efficient effluent treament based on an automatic control or an on-line coal ash meter using a radioactive isotope, are developed. A variable wave type air pulsated jig and a high level cleaning technique by which ash is removed to less than 1% and sulfur is also removed, are studied. 3 figs.

13944 (ETDE-mf–1764469) **Continuous vacuum-condensation-drying of hard coal finest particles water-suspensions.** Kroemer, E.A.; Roedel, A. Technische Univ. Berlin (Germany, F.R.). Fachbereich 10 - Verfahrenstechnik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Dec 1990 83p. (In German). Contract BMFT 032-6235-B. Order Number DE91764469. Source: OSTI; NTIS (US Sales Only).

Based on Patent DE 21914181 C2 two reactors are developed and constructed in laboratory- and pilot-scale. The pilot-scale reactor can be operated continuously. The basic research was done with hard coal finest particles. The influence parameters for the drying process are subject of investigation for contact heating and energy input by micro-waves. The process is in general useful for fine particles drying by using waste heat. For reducing the drying time it was investigated the combination of contact and micro-wave heating. The process is qualified for the drying of temperature sensitive materials. (orig.) With 64 refs., 9 tabs., 34 figs.

13945 (STEV-TORV–90-12) **Basic studies concerning dewatering of peat.** Ringqvist, L. (Statens Lantbrukskemiska Lab., Umeaa (SE)). Statens Energiverk, Stockholm (Sweden). 1990. 51p. (In Swedish, English). Project STEV-216-089. Order Number DE91763510. Source: OSTI; NTIS (US Sales Only).

In this project the effect of different pretreatment and mechanical dewatering methods on the capacity in a peat production system were studied. The variation between different peat types were regarded. The presence of fine particles in peat is one of the main reasons why peat is so difficult to dewater. Microscopy and image analysis were used to measure the particle size after chemical additives, freezing and mild wet carbonization. From this study it can be concluded that it is more important to obtain large aggregates than that the aggregation of the finest particles is complete. Freezing created the largest flocs, followed by cationic polyelectrolyte addition. The filtration result is much more dependent on which pretreatment method that has been used than the press step is.

High dry solid values can not be obtained with filtration, high pressure must be used. Very high capacity can be obtained during filtration. To obtain as high production capacity as possible a low pressure filtration should in some cases precede high pressure. The surface load during filtration should be kept low and the solid content high in the slurry to reach a high capacity after lowering pH, freezing and mild wet carbonization. After addition of polyelectrolyte the D.S. content in the slurry was of minor importance. When polyelectrolyte were added below optimum concentration, a low pH in the slurry gave higher capacity than aluminium addition. The difference in dewatering effect between anionic and cationic polyelectrolyte was small. A new method for pretreatment of peat was found. The method is based upon addition of iron and hydrogen peroxide. The filtration capacity is comparable to that of polymer treated peat. (author).

13946 Peat compositions and their manufacture. Field, J.R. 25 Sep 1990. Filed date 12 Feb 1990. Canada Patent patent application 2009797. 15p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A process for removing water from peat to form a solid, autothermally combustible fuel comprises the steps of contacting the peat with a dewatering liquid and then extracting a water-in-oil emulsion. Extraction of the emulsion from the mixture is generally performed by processes of the type used for dewatering aqueous flocculated peat slurries, for example pressure filtration on a belt press. The dewatering liquid consists of a water-immiscible solvent, preferably kerosenes, and dissolved water-in-oil emulsifier, preferably nonyl phenol-ethylene oxide condensate (Span 80) and sorbitan monooleate (Montane 80). The peat is preferably treated with an absorbent material comprising a water-swellable polymer to effect preliminary drying. The process of the invention can be carried out on a large or small scale, and is applicable not only to peat but to other wet combustible organic solids. Experiments are described to illustrate the process of the invention. 6 tabs.

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Refer also to citation(s) 13983, 13984, 13985, 13992, 13993, 13995, 14048, 14366, 14367, 14398, 14399, 14400, 14484, 14759, 14779

13947 (CONF-910601–1) **Separating hydrogen from coal gasification gases with alumina membranes.** Egan, B.Z. (Oak Ridge National Lab., TN (USA)); Fain, D.E.; Roettger, G.E.; White, D.E. Oak Ridge National Lab., TN (USA). [1991]. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 36. international gas turbine and aeroengine congress and exposition: ASME turbo expo; Orlando, FL (USA); 3-6 Jun 1991. Order Number DE91004540. Source: OSTI; NTIS; GPO Dep.

Synthesis gas produced in coal gasification processes contains hydrogen, along with carbon monoxide, carbon dioxide, hydrogen sulfide, water, nitrogen, and other gases, depending on the particular gasification process. Development of membrane technology to separate the hydrogen from the raw gas at the high operating temperatures and pressures near exit gas conditions would improve the efficiency of the process. Tubular porous alumina membranes with mean pore radii ranging from about 9 to 22 Å have been fabricated and characterized. Based on hydrostatic tests, the burst strength of the membranes ranged from 800 to 1600 psig, with a mean value of about 1300 psig. These membranes were evaluated for separating hydrogen and other gases. Tests of membrane permeabilities were made with helium, nitrogen, and carbon dioxide. Measurements were made at room temperature in the pressure range of 15 to 589 psi. Selected membranes were tested further with mixed gases simulating a coal gasification product gas. 5 refs., 7 figs.

13948 (DOE/MC/24266–2966) **Task 4, Mild gasification technology development system integration studies, April 1989–September 1990.** Knight, R.A.; Gissy, J.; Onischak, M.; Carty, R.; Babu, S.P.; Wootten, J.M.; Duthie, R.G. Institute of Gas Technology, Chicago, IL (USA). Dec 1990. 77p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC21-87MC24266. Order Number DE91002052. Source: OSTI; NTIS; GPO Dep.

The IGT mild gasification process incorporates an integrated fluidized-bed/entrained-bed reactor with heat supplied by a combination of hot char and gas recycle. The use of mild operating conditions (1000 to 1500°F), low pressures (<50 psig), and continuous operation in closed reactors, combined with the potential value-added benefits from the sale of co-products, offer an economical and environmentally sound approach to advanced coal utilization. The tests conducted as Task 4 operated with a full-stream product gas condensate system that was added to the process research unit (PRU). In these tests, the use of recycled char from previous tests mixed with the caking coal feed to the fluidized bed simulated the scale-up process design for the adiabatic process development unit (PDU) using recycled hot char. Also, one test was performed to evaluate the effect of carbon dioxide in the inlet fluidization gas, as would be present in the PDU design using heated recycled product gas for fluidization. Co-product yields and quality were compared with Task 2 data and related to sequential char recycle, fluidization gas, and coal type. Oils/tars yields with Illinois and West Virginia bituminous coals were consistently over 25% by weight of moisture- and ash-free coal, and were not adversely affected either by replacement of coke diluent with mild gasification char or by the use of 19% CO_2 in the fluidization gas. Condensable co-products from the Task 4 PRU tests were evaluated by Reilly Industries for the production of chemicals and pitch binders, and recommendations for liquids upgrading for incorporation into the 24-ton/h PDU design were made. Larger batches of char were generated for preparation of form coke and smokeless fuel briquettes to be tested. 3 refs., 4 figs., 31 tabs.

13949 (DOE/MC/26367–2958) **Production of low-cost hydrogen: Technical progress report, July 1990–September 1990.** Manufacturing and Technology Conversion International, Inc., Columbia, MD (USA). [1990]. 29p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC21-89MC26367. (MTCI–26367-108). Order Number DE91008912. Source: OSTI; NTIS; GPO Dep.

This fourth Quarterly Technical Progress Report presents the results of work accomplished during the period June 25, 1990 through September 30, 1990. The overall objective of this program is to verify the ability of the MTCI indirectly heated fluid-bed gasifier to produce a hydrogen-rich product gas from liquefaction by-product streams and from char produced in mild gasification processes. A shakedown test for mild gasification was done during this period. During this test, Eagle Butte Coal was fed at 100 lb/hr with steam fluidization. The start-up was limestone. After about $2\frac{1}{2}$ hours of testing, the test was terminated to make some system modifications to the lock hopper seals and the purge line. It was also discovered that the heat exchanger tubes were partially plugged with lime from the previous shakedown tests. Finally, a char production test was run for 40 hours continuously using the Black Thunder coal at an average feed rate of about 90 lbs/hr (ranging from 60 to 120 lbs/hr). Detailed elemental analysis will be performed after liquid analyses from AMOCO and DOE are obtained. 10 figs., 7 tabs.

13950 (DOE/METC–90/6112, pp. 91-104) **Status of gasification demonstration plants.** Rath, L.K. (Morgantown Energy Technology Center, WV (USA)). USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

In the period of time between the two oil embargoes, a number of medium-sized to large pilot plant programs were started by the U.S. DOE and its predecessor organizations, with and without private sector cost sharing. Most of the technologies being developed in that era were geared to large-scale coal gasification to make synthetic natural gas and largely feel by the wayside due to technical difficulties, scale-up considerations, and a rather large natural gas bubble. Other technologies under development during that timeframe were primarily geared for power generation application with combined cycles. Technologies in gasification supported by

DOE covered the spectrum of fixed-bed, fluidized-bed, and entrained-bed gasification. All of the development efforts ceased except for fixed- and fluidized-bed gasification development, which continued until recently and still could emerge out of the DOE Clean Coal Technology (CCT) Program, where the government shares up to half the cost of demonstration. This paper will review all the major viable gasification processes with major U.S. public or private involvement from a technology and state of development aspect. It will also review a potential new gasification technology called a transport reactor that could have significant cost and efficiency advantages over the current-day spectrum of technologies.

13951 (DOE/METC–90/6112, pp. 105-120) **Status of hot gas cleanup technology.** Bedick, R.C. (Morgantown Energy Technology Center, WV (USA)). USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

One objective of the Gas Stream Cleanup Program at the U.S. Department of Energy's Morgantown Energy Technology Center is to develop technologies to control contaminants in integrated coal gasification/fuel cell systems. The two primary gasification/fuel cell systems that are under investigation are the molten carbonate fuel cell (MCFC) and solid oxide fuel cell (SOFC) systems. In assessing contaminant control requirements for a gasification/fuel cell system, it is essential to look beyond preservation of the fuel cell. For example, it will be necessary to control nitrogen oxide emissions in MCFC systems that combust the gas at the exit of the anode. In assessing contaminant control requirements for a gasification/fuel system, it is essential to look beyond preservation of the fuel cell. For example, it will be necessary to control nitrogen oxide emissions in MCFC systems that combust the gas at the exit of the anode. In addition, it may be necessary to reduce alkali levels in the fuel gas to prevent damage to other system components, such as ceramic filters and turbine expanders, and it will be necessary to remove particles to prevent excessive pressure drop in packed-bed sorbent reactors. This paper provides a brief summary of contaminant control technologies that have potential significance for fuel cell systems. The paper describes control of particulates, sulfur nitrogen compounds, alkali, chlorides, tar, and trace contaminants.

13952 (DOE/METC–90/6115-Vol.1) **Proceedings of the tenth annual gasification and gas stream cleanup systems contractors review meeting: Volume 1.** Kothari, V.P.; Beeson, J.L. (eds.). USDOE Morgantown Energy Technology Center, WV (USA). Aug 1990. 373p. Sponsored by USDOE, Washington, DC (USA). (CONF-900853–Vol.1: 10. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (USA), 28-30 Aug 1990). Order Number DE90009689. Source: OSTI; NTIS; GPO Dep.

The Tenth Annual Gasification and Gas Stream Cleanup Systems Contractors Review Meeting was held August 28–30, 1990 at the Lakeview Resort and Conference Center in Morgantown, West Virginia. This meeting was sponsored and hosted by the Morgantown Energy Technology Center of the US Department of Energy. The purpose of the meeting was threefold: to review the technical progress and current status of the gasification and gas stream cleanup projects sponsored by the Department of Energy. To foster technology exchange among participating researchers and other technical communities. To facilitate interactive dialogue which would identify novel concepts that would make coal-based gasification and hot gas cleanup systems more attractive economically and environmentally. Two hundred thirty representatives of government, academia, industry, and foreign energy research organizations attended the three-day meeting. Thirty papers and thirty-three poster displays were presented summarizing recent developments in the gasification and gas stream cleanup programs. Scientists, engineers, and administrators discussed many of the issues facing those engaged in the research and development activities that constitute these programs. This document records Volume 1 of the proceedings of that meeting, and summarizes the gasification and gas stream cleanup programs. Individual papers have been catalogued separately.

13953 (DOE/METC–90-6115-Vol.2) **Proceedings of the tenth annual gasification and gas stream cleanup systems contractors review meeting: Volume 2.** Kothari, V.P.; Beeson, J.L. (eds.). USDOE Morgantown Energy Technology Center, WV (USA). Aug 1990. 262p. Sponsored by USDOE, Washington, DC (USA). (CONF-900853–Vol.2: 10. annual gasification and gas stream cleanup systems contractors review meeting, Morgantown, WV (USA), 28-30 Aug 1990). Order Number DE90009690. Source: OSTI; NTIS; GPO Dep.

The Tenth Annual Gasification and Gas Stream Cleanup Systems Contractors Review Meeting was held August 28–30, 1990 at the Lakview Resort and Conference Center in Morgantown, West Virginia. This meeting was sponsored and hosted by the Morgantown Energy Technology Center of the US Department of Energy. The purpose of the meeting was threefold: to review the technical progress and current status of the gasification and gas stream cleanup projects sponsored by the Department of Energy. To foster technology exchange among participating researchers and other technical communities. To facilitate interactive dialogue which would identify novel concepts that would make coal-based gasification and hot gas cleanup systems more attractive economically and environmentally. Two hundred thirty representatives of government, academia, industry, and foreign energy research organizations attended the three-day meeting. Thirty papers and thirty-three poster displays were resented summarizing recent developments in the gasification and gas stream cleanup programs. Scientists, engineers, and administrators discussed many of the issues facing those engaged in the research and development activities that constitute these programs. This document records the Volume 2 of the proceedings of that meeting, and summarizes the gasification and gas stream of cleanup programs. Individual papers have been catalogued separately.

13954 (DOE/PC/79876–T1) **Enhancement of microbial coal desulfurization: Final report.** ARCTECH, Inc., Alexandria, VA (USA). Nov 1990. 175p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-87PC79876. Order Number DE91009480. Source: OSTI; NTIS; GPO Dep.

In order to use the vast fossil fuel resources of the United States while maintaining environmentally acceptable pollutant emissions, cleaning technologies capable of upgrading the fuels are required. ARCTECH is developing microorganisms which may produce a clean, environmentally safe fuel at low cost from otherwise unusable coal reserves. Several microoganisms isolated by ARCTECH from natural environments release sulfur from chemical functional groups thought to be found in coals. CB3, a mixed culture derived from Upper Freeport coal, grows using dibenzothiophene (DBT) as a sole sulfur source. Studies demonstrated that most of the DBT-degrading activity is associated with the membrane fraction. Sulfur is released from the model compound as sulfate, and ring cleavage appears to occur after sulfur release. A modified 4S Pathway for DBT degradation is proposed. 24 refs., 74 figs., 30 tabs.

13955 (DOE/PC/88812–T7) **Process and analytical studies of enhanced low severity co-processing using selective coal pretreatment: Quarterly technical progress report, September–November 1990.** Baldwin, R.M.; Gaur, S.; Miller, R.L. Colorado School of Mines, Golden, CO (USA). Dept. of Chemical Engineering and Petroleum Refining. [1990]. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-88PC88812. Order Number DE91008364. Source: OSTI; NTIS; GPO Dep.

This report describes progress on research during the eighth quarter of this contract dealing with applications of coal pretreatment techniques in coal/oil co-processing and direct hydroliquefaction. The objectives of the project are to investigate various coal pretreatment techniques and to determine the effect of these pretreatment procedures on the reactivity of the coal. Reactivity enhancement will be evaluated under both direct hydroliquefaction and co-processing conditions. Coal conversion utilizing low rank coals and low severity conditions (reaction temperatures generally less than 350 C) are the primary focus of the liquefaction experiments, as it is expected that the effect of pretreatment conditions and the attendant reactivity enhancement will be greatest for these coals and at these conditions. This document presents a comprehensive report summarizing the findings of a

study carried out during the past quarter on the effect of catalyst on conversion of coal to THF and hexane soluble materials. Two coals from the Argonne Premium Sample Bank (Beulah-Zap) lignite and Utah Blind Canyon high volatile bituminous were utilized in the experimental matrix. Liquefaction data were obtained from tubing bomb microautoclave experiments over a broad temperature range (310-425 C), and reaction profiles were measured at residence times of 5, 10, 15, and 30 minutes in order to elucidate the effect of both time and temperature at reaction conditions ranging from low to high severity. The primary influence of catalyst was found to be in terms of promoting conversion of coal to hexane solubles. A hexane selectivity parameter was developed and utilized to provide insight into the role and effect of catalyst. 2 refs., 14 figs., 1 tab.

13956 (DOE/PC/88891–T4) **Molecular biological enhancement of coal biodesulfurization: Ninth quarter report, November 1990–January 1991.** Kilbane, J.J. II; Bielaga, B.A. Institute of Gas Technology, Chicago, IL (USA). Jan 1991. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-88PC88891. Order Number DE91008358. Source: OSTI; NTIS; GPO Dep.

During this quarter, November 1990 to January 1991, substantial progress has been made in coal biodesulfurization experiments, methods development, strain improvement, and in biochemical studies of the desulfurization trait of IGTS8. Biodesulfurized coal samples and controls were sent to Iowa State University for the direct determination of organic sulfur by the electron microbeam technique. Preliminary results of those analyses confirm that organic sulfur reductions of about 39% were observed in biotreated coal samples. Water-soluble coal-derived hydrocarbons were used in biodesulfurization experiments and preliminary results indicate that as much as 86% sulfur removal has been achieved with a 24 hour treatment time. Mutants of IGTS8 have been obtained that continue to express the desulfurization trait even in the presence of high levels of sulfate. Genetic experiments have succeeded in transforming a Rhodococcus rhodochrous culture (ATCC No. 13808) with a newly obtained plasmid, pRF38. Biochemical studies of IGTS8 have revealed that no desulfurization activity can be detected in culture supernatants or in the extra-cellular fluids of sonicated cell cultures. Additionally, research has confirmed that IGTS8 specifically removes sulfur from DBT-sulfone resulting in the production of 2-hydroxybiphenyl. 2 figs., 3 tabs.

13957 (DOE/PC/88916–T1) **Indirect electrolysis process for removal of pollutants from coal liquids: Quarterly report, October 1, 1990–December 31, 1990.** Colorado Univ., Boulder, CO (USA). [1990]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-88PC88916. Order Number DE91009497. Source: OSTI; NTIS; GPO Dep.

In previous reports the authors introduced their model for a three step process. The main purpose of this report is to show the calculation of the diffusion coefficients for each step and compare the experimental results with the modeling results. The paper describes: the calculation of diffusion coefficients; the measurement of physical solubility of pollutant in Na^+ Nafion beads; and the measurement of physical solubility of pollutant in Fe(III) TMpyP-exchanged Nafion. 5 refs., 4 figs.

13958 (DOE/PC/88927–T5) **Mechanistic and kinetic studies of high-temperature coal gas desulfurization sorbents: Quarterly technical progress report No. 10.** Flytzani-Stephanopoulos, M.; Lew, S.; Sarofim, A.F. Massachusetts Inst. of Tech., Cambridge, MA (USA). Dept. of Chemical Engineering. Feb 1991. 78p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-88PC88927. Order Number DE91009491. Source: OSTI; NTIS; GPO Dep.

The sulfidation of bulk mixed oxides of zinc and titanium of various compositions and Zn-Ti-O crystalline phases in H_2S-H_2-H_2O-N_2 gas mixtures was investigated in a thermogravimetric apparatus over the temperature range of 400–800°C. Comparative sulfidation experiments with ZnO were also performed. In comparison to ZnO, the use of Zn-Ti-O solids allows raising the operating temperature for desulfurization of hot coal-derived fuel gas. The initial sulfidation rate of Zn-Ti-O solids with $(Zn/Ti)_{atomic} \leq 3$ was apparently 1.5–2 times slower than for ZnO. Different zinc titanate phases had the same initial sulfidation rate. Similar activation energies were measured for ZnO and Zn-Ti-O sulfidation. No effect of H_2 or H_2O was observed on the initial sulfidation rate. However, at high conversions, rates were lower with increasing H_2 concentrations. Fine particles and cracks were observed in sulfided ZnO as a result of ZnO reduction and subsequent vapor phase reaction between Zn and H_2S to form ZnS. These structural effects were largely absent in Zn-Ti-O solids. The overlapping grain model is used to describe the sulfidation of zinc oxide and zinc-titanium oxide powders at temperatures between 400–700°C in a H_2S-H_2-N_2 gas mixture. Resistances to reaction are attributed to intrinsic sulfidation kinetics (surface reaction) and diffusion through the product layer. As the relative amount titanium in the sorbent is increased, the product layer diffusion coefficient decreases. Similar activation energies were obtained for the product layer diffusion coefficient of ZnO and Zn-Ti-O solids undergoing sulfidation. From the similarity in activation energies, it is proposed that for both types of sorbents diffusion occurs primarily through ZnS. 31 refs., 29 figs., 8 tabs.

13959 (DOE/PC/88935–T8) **Inhibition of retrogressive reactions in coal/petroleum co-processing: Quarterly technical progress report, September 1, 1990–November 30, 1990.** Schobert, H.H.; Tomic, J. Pennsylvania State Univ., University Park, PA (USA). Coll. of Earth and Mineral Sciences. Dec 1990. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-88PC88935. Order Number DE91009507. Source: OSTI; NTIS; GPO Dep.

The overall objective of this project is to develop a fundamental understanding of the reactions occurring at the onset of coke formation during the co-processing of coals with petroleum residua. The specific objectives include examination of chemical components, or groups of components, in coals and petroleum feedstocks to quantify and rank the effects of these components in retarding or enhancement of coke formation. The work involves bench scale reactions in microautoclaves, supplemented by studies of the carbonaceous residues by such techniques as diffuse reflectance Fourier transform infrared spectroscopy and ^{13}C nuclear magnetic resonance spectrometry. The focus of the work during this reporting period was statistical analysis of the results from the reactions of the five project coals with five model compounds: eicosane, 1-phenyldodecane, 1,4-diisopropylbenzene, durene, and pyrene. Independent variables for the coals and the model compounds were selected and correlated with the yield of tetrahydrofuran (THF) solubles, which is the dependent variable. The results of the linear regression analyses indicate that the greatest influence of the model compounds is the tendency to crack and the partitioning of the model compounds between vapor and liquid at the highest reaction temperature. The influence of the coal composition seems to differ depending on the gas atmosphere, nitrogen or hydrogen. The statistical analyses of the results from the reactions obtained under a hydrogen atmosphere and a reaction temperature of 400°C were unique. 4 refs., 4 figs., 3 tabs.

13960 (DOE/PC/88940–T6) **Fundamental studies in production of C_2-C_4 hydrocarbons from coal: Progress report No. 8, June 1, 1990–August 31, 1990.** Wiser, W.H.; Oblad, A.G. Utah Univ., Salt Lake City, UT (USA). Dept. of Fuels Engineering. Sep 1990. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-88PC88940. Order Number DE91008967. Source: OSTI; NTIS; GPO Dep.

An envelope of parameter values has been experimentally identified in this laboratory, heretofore unexplored, for the catalytic hydrogenation and hydrocracking of coal which leads to yields of C_2-C_4 hydrocarbons in excess of 50 weight percent of the coal, in a direct, single stage process under mild conditions. In this research program, an innovative and highly sophisticated reactor system, designed and constructed by the authors, will obtain data to define the reaction pathways leading directly from coal to high yields of C_2-C_4 hydrocarbons, and to provide insight into the mechanisms of the conversion reactions. A computer program will be developed to define the maximum yields of C_2, C_3, and C_4 hydrocarbons thermodynamically possible in such a system, as a function of temperature, pressure and percent steam in the steam-hydrogen stream to the reactor, for the type of dual-functional catalyst identified as essential to the conversion process. The

process will then be optimized for production of each of the hydrocarbons C_2, C_3, and C_4, and for production of olefins among these hydrocarbons. Preliminary results are described.

13961 (DOE/PC/89658–T2) **Innovative coke oven gas cleaning system for retrofit applications: Quarterly technical progress report No. 2, April 1, 1990–June 30,1990.** Bethlehem Steel Corp., PA (USA); Davy/Still-Otto, Pittsburgh, PA (USA). 10 Sep 1990. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC22-90PC89658. Order Number DE91008365. Source: OSTI; NTIS; GPO Dep.

All of the project work since the previous report has been on Phase 2B tasks. Therefore, this quarterly progress report summarizes the period's activities in Engineering, Procurement and Civil Construction. Engineering is 95% complete, but revisions and changes are still being incorporated particularly in the Instrument and Electrical areas. Procurement has only valves 4 in. and above yet to order to complete all major items purchased. The scheduled material curve was based on the original estimate of the job. The projected curve reflects the previous month's estimate. Construction of civil work is proceeding according to schedule in the field. The initial bid packages for the Mechanical General Contractor portion of the work have been reviewed and evaluated. Order placement is scheduled for the end of July. The Electrical package is due back from the bidders on July 6. It requires additional evaluation by BSC and DSO and will not be placed until late August. The cost of the project is ahead of the cost or spending plan because of the accelerated progress in the field and early delivery of equipment. However, there are some concerns that the mechanical and electrical bid packages are higher than planned. Although we plan to determine the causes of the increases, we do not intend to let it effect the progress of the project. 7 figs.

13962 (DOE/PC/89760–T2) **A novel approach to highly dispersing catalytic materials in coal for gasification: Third quarterly report, April 1, 1990–June 30, 1990.** Abotsi, G.M.K.; Bota, K.B. Clark Atlanta Univ., GA (USA). Research Center for Science and Technology. [1990]. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89760. Order Number DE91008943. Source: OSTI; NTIS; GPO Dep.

This project seeks to develop a technique, based on coal surface properties, for highly dispersing catalysts in coal for gasification and to investigate the potential of using potassium carbonate and calcium acetate mixtures as catalysts for coal gasification. The lower cost and high catalytic activity of the latter compound will produce economic benefits by reducing the amount of K_2CO_3 required for high coal char reactivities. The work is focused on the elucidation of coal-catalyst precursor interactions in solution and the variables which control the adsorption and dispersion of coal gasification metal catalysts. In order to optimize coal-metal ion interactions and hence maximize catalyst activity, the study examines the surface electrochemistry of a lignite, subbituminous, and bituminous coals and their demineralized and oxidized derivatives prior to loading with the catalytic materials. The surface electrical properties of the coals are investigated with the aid of electrophoresis, while the effects of the surface charge on the adsorption of K^+ and Ca^{2+} are studied by agitating the coals with aqueous solutions of potassium or calcium. Zeta potential studies show that the surfaces of the coals are negatively charged between about pH 2 to 11, the negative charge density increased with increase in pH and decreased with increase in coal rank. Highly alkaline media promoted calcium and potassium adsorption due to the high negative charge density on the coals, while uptake of the metals was inhibited in strongly acidic solutions. The latter conditions also resulted in the extraction of inherent iron from the coals into solution. 11 refs., 4 figs., 1 tab.

13963 (DOE/PC/89772–T2) **Applications of micellar enzymology to clean coal technology: Fifth quarterly report.** Walsh, C.T. Boston Univ., MA (USA). School of Medicine. 22 Jan 1991. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89772. Order Number DE91009501. Source: OSTI; NTIS; GPO Dep.

This project is designed to develop methods for pre-combustion coal remediation by implementing recent advances in enzyme biochemistry. The novel approach of this study is incorporation of hydrophilic oxidative enzymes in reserve micelles in an organic solvent. Dibenzothiophene (DBT) and ethylphenylsulfide (EPS) are serving as models of organic sulfur-containing components of coal in initial studies. The major focus of the fifth quarter has been development of studies for determination of enzymatic oxidation of ethylphenylsulfide (EPS) to ethylphenylsulfide (EPSx) and ethylphenylsulfone (EPSn). Protocols for analysis of the oxidative activity of chloroperoxidase in aqueous and reserve micelle solution were designed. The activity of this enzyme in aqueous solution was confirmed with a conventional substrate. Preliminary studies with EPS as substrate did not reveal oxidation to EPSx or EPSn. However, recovery of metabolite standards by liquids extraction and thin layer chromatography (TLC) was less than expected. Bond Elut columns were obtained to test their feasibility in concentrating metabolites and separating them from solution components. 11 refs., 2 figs., 4 tabs.

13964 (DOE/PC/89783–T1) **Fundamental studies of catalytic processing of synthetic liquids: Quarterly progress report, September 1, 1990–December 31, 1990.** Watson, P.R. Oregon State Univ., Corvallis, OR (USA). 24 Jan 1991. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89783. Order Number DE91009487. Source: OSTI; NTIS; GPO Dep.

This project revolves around understanding the fundamental processes involved in the catalytic removal of harmful oxygenated organics present in coal liquids. The investigators are modelling the complex type of sulfided Mo catalyst proposed for these reactions with simple single crystal surfaces. They then investigate the reaction pathways for representative simple oxygenates upon these surfaces. The original plans for this quarter called for continuing study of the interesting reactions of furan on sulfided Mo(100) surfaces presented in the last report. Due to the unfortunate accidental destruction of this sample, the investigators have in fact proceeded on two alternate fronts. First they have improved the sample heating system, the malfunction of which caused the loss of the Mo crystal. Secondly, they have prepared a Mo(110) surface and performed initial experiments to understand the sulfur phases that form on this surface of Mo. These efforts have been worthwhile - they have accomplished on the (110) surface in two months what required almost six months on the (100) surface, and are in a good position to repeat the furan reaction experiments on Mo(110) surfaces. The heating system design is described and results of surface properties are given. 2 refs., 5 figs.

13965 (DOE/PC/89788–T2) **Novel process for depolymerization of coal to C_2-C_4 hydrocarbons: Progress report No. 5, September 1, 1990–November 30, 1990.** Wiser, W.H.; Oblad, A.G. Utah Univ., Salt Lake City, UT (USA). Dept. of Fuels Engineering. Dec 1990. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89788. Order Number DE91009490. Source: OSTI; NTIS; GPO Dep.

An envelope of parameter values has been experimentally identified in the authors laboratory, heretofore unexplored, for the catalytic depolymerization of coal which leads to yields of C_2-C_4 hydrocarbons in excess of 50 weight percent of the coal, in a direct, single stage process under mild conditions. The recycle liquid solvent will be characterized, and is expected to constitute a supercritical phase under conditions of temperature and pressure imposed by the chemistry of the system. Using a special reactor incorporating windows for visual observation, the operation of a catalyst bed fluidized by super-critical, coal-derived fluids will be examined. The capability of such a super-critical, coal-derived fluid to control agglomerization of a strongly caking coal, in the catalyst bed, will be evaluated, and satisfactory control developed. Solvent upgrading of the recycled liquids will be applied as may be required. Finally, a continuous reactor system will be designed, constructed and operated, based upon the information obtained form the experiments identified herein. This report describes procurement of the reactor.

13966 (DOE/PC/89788–T3) **Novel process for depolymerization of coal to C_2-C_4 hydrocarbons: Progress report No. 4, June 1, 1990–August 31, 1990.** Wiser, W.H.; Oblad, A.G. Utah Univ., Salt Lake City, UT (USA). Dept. of Fuels Engineering. Sep 1990. 4p. Sponsored by USDOE, Washington, DC (USA). DOE

Contract FG22-89PC89788. Order Number DE91009489. Source: OSTI; NTIS; GPO Dep.

An envelope of parameter values has been experimentally identified in this laboratory, heretofore unexplored, for the catalytic depolymerization of coal which leads to yields of C_2-C_4 hydrocarbons in excess of 50 weight percent of the coal, in a direct, single stage process under mild conditions. The recycle liquid solvent will be characterized, and is expected to constitute a super-critical phase under conditions of temperature and pressure imposed by the chemistry of the system. Using a special reactor incorporating windows for visual observation, the operation of a catalyst bed fluidized by super-critical, coal-derived fluids will be examined. The capability of such a super-critical, coal-derived fluid to control agglomerization of a strongly caking coal, in the catalyst bed, will be evaluated, and satisfactory control developed. Solvent upgrading of the recycled liquids will be applied as may be required. Finally, a continuous reactor system will be designed, constructed and operated, based upon the information obtained from the experiments identified herein, as well as from a companion research project, coupled with the extensive experience and knowledge with related systems, as well as information to be found in the current literature. No results are available as yet.

13967 (DOE/PC/89867–T2) **Slurry reactor design studies: Slurry vs. fixed-bed reactors for Fischer-Tropsch and methanol: Final report.** Fox, J.M. (Bechtel Group, Inc., San Francisco, CA (USA)); Degen, B.D.; Cady, G.; Deslate, F.D.; Summers, R.L.; Akgerman, A.; Smith, J.M. Bechtel Group, Inc., San Francisco, CA (USA). Jun 1990. 253p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-89PC89867. Order Number DE91005752. Source: OSTI; NTIS; GPO Dep.

The objective of these studies was to perform a realistic evaluation of the relative costs of tublar-fixed-bed and slurry reactors for methanol, mixed alcohols and Fischer-Tropsch syntheses under conditions where they would realistically be expected to operate. The slurry Fischer-Tropsch reactor was, therefore, operated at low H_2/CO ratio on gas directly from a Shell gasifier. The fixed-bed reactor was operated on 2.0 H_2/CO ratio gas after adjustment by shift and CO_2 removal. Every attempt was made to give each reactor the benefit of its optimum design condition and correlations were developed to extend the models beyond the range of the experimental pilot plant data. For the methanol design, comparisons were made for a recycle plant with high methanol yield, this being the standard design condition. It is recognized that this is not necessarily the optimum application for the slurry reactor, which is being proposed for a once-through operation, coproducing methanol and power. Consideration is also given to the applicability of the slurry reactor to mixed alcohols, based on conditions provided by Lurgi for an Octamix™ plant using their standard tubular-fixed reactor technology. 7 figs., 26 tabs.

13968 (DOE/PC/89903–T2) **Cloning and expression of the sulfoxide/sulfone/sulfonate/sulfate genes in pseudomonads and thiobacillae: Annual report.** Krawiec, S. Lehigh Univ., Bethlehem, PA (USA). Dept. of Biology. 22 Jul 1990. 19p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-89PC89903. Order Number DE91008946. Source: OSTI; NTIS; GPO Dep.

One of the principal goals of the contracted research is to transfer the genetic determinates for the oxidation of thiophenic sulfur from soil isolates to other organisms. This goal has been fulfilled during the first year of the contract. Two aspects of the work deserve emphasis. One is that standards were exacting; protocols were repeatedly refined to produce clear cut demonstrations of genetic transfer. The second is that the methods are general; they are applicable to fresh isolates having novel phenotypes pertaining to the sulfoxide/sulfone/sulfonate/sulfate pathway. Since coals differ in the abundances and forms of organic sulfur present, general techniques for cloning a variety of genes specifying the Dbt$^+$ phenotype are important. 22 refs.

13969 (DOE/PC/89903–T3) **Molecular biological enhancement of coal desulfurization: Cloning and expression of the sulfoxide/sulfone/sulfonate/sulfate genes in pseudomonads and thiobacillae: Sixth quarterly report, [October–December 1990].** Krawiec, S. Lehigh Univ., Bethlehem, PA (USA). Dept. of Biology. 4 Feb 1991. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-89PC89903. Order Number DE91009492. Source: OSTI; NTIS; GPO Dep.

A genetic character is a stable, heritable feature of an organism. Such genetic features are manifest in phenotypes. The preceding claims are fundamental tenets of genetic analysis. Observations which conform to these claims are reliable. But sometimes observations from carefully executed experiments do not correspond with expectation. Traits sometimes are not stable, or they are transmitted irregularly to subsequent generations, or the phenotype exhibits variation for reasons which are not readily identifiable. Such confounding circumstances have characterized the research efforts of the Lehigh group during the past quarter. A useful aspect of unanticipated laboratory observations is that they necessitate an examination of the hypotheses, protocols, procedures, materials et cetera used in experimentation. Much of the progress during the current quarter comes from such assessments. 17 refs.

13970 (DOE/PC/90013–T14) **Optimum catalytic process for alcohol fuels from syngas: Final technical report.** Dombek, B.D. Union Carbide Chemicals and Plastics Co., Inc., South Charleston, WV (USA). Solvents and Coatings Materials Div. Sep 1990. 427p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-86PC90013. Order Number DE91007497. Source: OSTI; NTIS; GPO Dep.

The objectives of this contract were to discover and evaluate the catalytic properties of novel homogeneous, heterogeneous, or combination catalytic systems for the production of fuel alcohol extenders from syngas, to evaluate analytically and on the bench scale novel reactor concepts for use in converting syngas to liquid fuel products, and to develop on the bench scale the best combination of chemistry, reactor, and total process configuration to achieve the minimum product cost for conversion of syngas to liquid fuel products. This was to be done through extensions of known catalyst systems and by design of novel systems. The characteristics of these catalysts which affect their performance in alcohol synthesis-selectivity, activity, and stability - were to be evaluated, and fundamental catalyst chemistry involved in syngas conversion to alcohols was to be studied.

13971 (DOE/PC/90037–T2) **Synthesis of model compounds for coal liquefaction research: Quarterly report No. 3, October 15, 1990–January 14, 1991.** Sen, P.K. IIT Research Inst., Chicago, IL (USA). 24 Jan 1991. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-90PC90037. Order Number DE91008359. Source: OSTI; NTIS; GPO Dep.

This report summarizes the actual laboratory investigations performed during the reporting period, which were aimed at achieving the stated objective of the project, viz., the synthesis of a model compound containing tetrahydronaphthalene, naphthalene and phenyl moieties linked by methylene, ethylene and ether bonds. The specific objective consists of the synthesis of the following three key intermediates, viz.,: (i) 2,4-dimethyl-5-bromobenzylchloride; (ii) 3-chloromethylene-2-hydroxytetralin; and (iii) 4-chloromethylene-1-hydroxynaphthalene. This report covers alternate approaches that were explored in order to obtain the key intermediates (i), (ii) and (iii). In addition, an attempt to scale up the preparation of the intermediates has also been initiated.

13972 (DOE/PC/90037–T3) **Synthesis of model compounds for coal liquefaction research: Quarterly report No. 2, July 14, 1990–October 14, 1990.** Sen, P.K. IIT Research Inst., Chicago, IL (USA). 8 Jan 1991. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-90PC90037. Order Number DE91008528. Source: OSTI; NTIS; GPO Dep.

This report covers the actual laboratory investigations performed during the reporting period, to attain the stated objective of the project viz., the synthesis of a model compound containing tetrahydronapthalene, napthalene and phenyl moieties linked by methylene, ethylene and ether bonds. The specific objective consists of the synthesis of three key intermediates and they are: (i) 3,5-dimethyl-6-bromo-benzylchloride; (ii) 1-chloromethylene-2-hydroxytetralin; and (iii) 2-chloromethylene-1-hydroxynaphthalene. This report covers alternate approaches that were explored in order to obtain the key intermediates (i), (ii) and (iii). In addition, an attempt at scale up of the intermediates has also been initiated.

13973 (DOE/PC/90312–T1) **Hot gas desulfurization with sorbents containing oxides of zinc, iron, vanadium and copper: Quarterly technical progress report, [October–December 1990].** Akyurtlu, A. Hampton Univ., VA (USA). Dept. of Engineering. Jan 1991. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-90PC90312. Order Number DE91008966. Source: OSTI; NTIS; GPO Dep.

The main objective of the proposed research is to evaluate the desulfurization performance of novel sorbents consisting of different combinations of zinc, iron, vanadium and copper oxides; and to develop a sorbent which can reduce H_2S levels to less than 1 ppmv, which can produce economically recoverable amounts of elemental sulfur during regeneration. This objective will be accomplished by evaluating the sorbent performance by fixed-bed and TGA experiments supported by sorbent characterization at various reaction extents. In this first quarter of study, the setting up of the experimental apparatus has been undertaken, involving designing the set-up, purchasing the required parts and starting the task of construction. Zinc ferrite and zinc titanate sorbents have been obtained. The required detector, columns and sampling valves for the Varian 3400 gas chromatograph has been ordered. The procedures for the preparation of the promoted sorbents have been prepared. 1 fig.

13974 (DOE/PC/90504–T18) **Configurational diffusion of coal macromolecules: Quarterly progress report, December 15, 1990–March 15, 1991.** Guin, J.A.; Curtis, C.W.; Tarrer, A.R. Auburn Univ., AL (USA). Coal Conversion Lab. [1991]. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-86PC90504. Order Number DE91008896. Source: OSTI; NTIS; GPO Dep.

It has been reported that the most predominant constituents of coal extract are the polycyclic aromatic hydrocarbons. Yet the experimental values of diffusivity in ethyl acetate for the most of these materials were not available in the literature. Thus, the diffusion coefficients of some of these materials were measured to increase an understanding of the diffusional behavior of coal macromolecules. In an earlier quarterly report, the authors reported the diffusion coefficients of some model coal molecules determined using their diffusion cell with polycarbonate membranes. Subsequently, they have found that these polycarbonate membranes are semi-permeable to some of the model compounds, so that the measured diffusion flux was greater than that through the pores alone. This extra solute flux could result in over estimation of the diffusion coefficients, therefore, they have now re-measured these diffusivities using polyester, rather than polycarbonate, membranes. The polyester material is not permeable to the solute molecules, except through the open pore area. Thus the only diffusion flux is that through the pores, resulting in correct diffusion coefficients as reported herein. The detailed results are presented in the body of this report. Finally in the last section the authors discuss a slight departure in methodology of some of their earlier planned work. This change will have a positive beneficial impact on the results and speed-up the collection of configurational diffusion data in actual tortuous porous media. 12 refs., 3 figs., 4 tabs.

13975 (DOE/PC/91257–T7) **Molten-Caustic-Leaching System Integration Project: Technical progress report, quarter ending December 28, 1990.** TRW, Inc., Redondo Beach, CA (USA). Applied Technology Div. [1990]. 58p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-86PC91257. Order Number DE91008539. Source: OSTI; NTIS; GPO Dep.

The objective of this project is to modify an existing molten-caustic-leaching system for operation in an integrated continuous manner. There are six major tasks in the overall strategy; however, only portions of the first three are reported here. The tasks described are: (1) maintenance and refurbishment of reactor section, wash section, and caustic regeneration; (2) design modifications of vacuum filter and caustic evaporator for integrated operations; and (3) offline testing of components, including coal sample inventory and procurement and analytical chemistry support. 11 tabs. (CK)

13976 (ETDE/JP-mf–1759127, pp. 84-91) **Development of coal hydrogenation.** Noguchi, F. (Osaka Gas Co. Ltd., Osaka (Japan)); Kobayashi, K. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper described a developing activity of the coal hydrogenation process. When coal is heated rapidly under the hydrogen atmosphere, the coal is pyrolyzed and the volatile matter reacts to generate gases mainly composed of methane and aromatic compounds. The Lower coal rank, is the more volatile matter, is the higher temperature, is and the higher pressure; is the larger the total carbon conversion rate becomes. Since BTX or liquid products show the peak within a temperature range, arbitrary products and the yield distribution can be obtained by controlling reaction temperature. A new reactor was devised to study problems concerning the fluidized bed or entrained bed. The 200kg/h pilot plant was operated and the total carbon conversion rate from 39 to 55% could be obtained (brown coal of higher volatile matter was highest) and the maximum conversion rate of 15% for BTX and liquid products could be obtained at the temperature of 900 centigrade or less. Char separated from the reactor was gasified by oxygen and steam and the economy of a commercial plant was evaluated on the premise of hydrogen production. Comprehensive thermal efficiency would be as high as 77-79% and the construction cost would be cheaper than that of conventional process. 10 figs., 2 tabs.

13977 (ETDE/JP-mf–1759127, pp. 92-96) **Support study for the development of an entrained-bed coal gasification power generation plant. I.: Outline of the support study.** Nakai, J. (The Coal Mining Research Center, Tokyo (Japan)). Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper described the supporting study for an entrained bed coal gasification power generation plant. An existing fluidizing bed gasification pilot plant of 40t/d was used to provide data and materials for an entrained bed pilot plant of 200t/d under the construction in Fukushima Prefecture. The gas refining equipment in Fukushima includes the hot desulfurization and dedusting equipments similar to those developed in Yubari, and the gas turbine temperature is 1,300 centigrade class similar to that in Yubari. Both are scheduled to be scaled up. The automatic operation for the desulfurization test was aimed by using an on-line gas analyser, and the load variation due to the pressure increase or decrease in the absorption and regeneration towers and the response could be grasped. The applicability of cheap fine coke powder was studied as a reducing agent for SO_2. Concerning the dedusting test, the improvement of separation by filtering with a sintered metal, automatization by digital controlling, load response and the applicability of cheap artificial mullite as a filter material were studied. As to the elementary tests of the gas turbine, their testing methods, prevention of corrosion and metal grades were reviewed. Stationary blades in the gas turbine were sound after the test because the corrosion could not be found on their inside and outside surfaces. 3 figs., 3 tabs.

13978 (ETDE/JP-mf–1759127, pp. 97-100) **Support study for the development of an entrained-bed coal gasification power generation plant. II.: Development of hot gas desulfurization process.** Sugitani, T. (Ishikawajima-Harima Heavy Industries Co. Ltd., Tokyo (Japan)); Kobayashi, S. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper described the operated result of the hot gas desulfurizing pilot plant in Ynbari to support the entrained bed coal gasification pilot plant of 200t/d capacity for power generation which is now constructed in the Nakoso Power Station in Fukushima Prefecture. The desulfurizing capacity is adapted to the 30t/d coal gasification capacity; tha gas is flown into the absorber (desulfurizer) from the lower part and S is absorbed in the 2 stage fluidized bed by forming iron sulfide. In the regenerator, iron sulfide is oxidized to iron oxide by air. S in gas is exhausted from the top as SO_2 and reduced to S element by coal to condensate and recover. Desulfurizer is crushed iron ore or other iron oxide which

circulates between the absorber and the regenerator to repeat the desulfurization and regeneration. Automatized equipments such as on-line analyzer were equipped to make the operation test and to get the characteristics such as load response, voltage transformation and partial load. The good desulfurization rate could be held even for the load variation equivalent to the pressure changing rate of 3%/min. In addition, the guideline to deliver the long-term operation reliability could be gotten. The suitability of fine powder coke as the reducing agent could also be verified. 3 figs.

13979 (ETDE/JP-mf–1759127, pp. 101-105) **Support study for the development of an entrained-bed coal gasification power generation plant. III.: Development of high temperature dry-type dust separator.** Kawamata, N. (Kawasaki Heavy Industries, Ltd., Tokyo (Japan)); Mori, T. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper described the result of the Yubari pilot plant for high temperature dry-type dust separator as the support research to construct and operate an entrained bed coal gasification power pilot plant of 200t/d capacity. Dust in gas is collected by filter layers in 2 moving bed dust collectors. Filter material flows uniformly down from upper part to lower part at the constant rate and dust containg gas passes across the filter layer. Filter material is extracted from the bottom and circulated to reuse after separating the dust. Inlet dust concentration of 2-3g/Nm^3 can be reduced to 1mg/Nm^3 at the outlet. Superior results could be obtained by the test to enable the improvement of separating performance, the stability of the sequence control for the filter material supplying and extracting system and the reliability improvement. A continuous type dust densitometer uses a light emitting diode as the light source and the accuracy was verified by comparing that with the JIS method. The automatized operation has no problems and the pressure variation does not affect the dust removing performance. Although Al spraying layer in the main body of dust collector is consumed, the base metal showed no abnormal conditions and the long term operating reliability could be verified. Highly strong and cheap synthetic filter material such as synthetic mullite was developed. 5 figs., 2 tabs.

13980 (ETDE/JP-mf–1759127, pp. 184-191) **Development of dewatering process of low rank coal.** Nakanishi, T. (The Coal Mining Research Center, Tokyo (Japan)); Mishima, A.; Ishikawa, K. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

In order to design the amplification in utilization of brown coal, it is necessary to economically constitute, simultaneously to developing an economical dewatering and deforming process, a through system, comprising all processes as far as the transportation and storage. Then as a brown coal deforming technology, non-evaporation dewatering/deforming method (DK process) was developed by heating by steam. That process is characterized by dewatering brown coal, through heating brown coal by steam in the autoclave, with a higher thermal efficiency than that by the steam drying, and further giving restriction of spontaneous ignition and other reforming effects. The DK process being originally a batch treatment, continuous DK process was developed, by material-sealing the internal autoclave pressure, to continuously treat brown coal. That process was elucidated in basic characteristics through laboratory scale test and confirmed to be constitutable as a process. By that process, briquette was produced to be equivalent in dewatered condition to that by the batch treatment, under lower temperature and pressure than those by it. 8 figs., 2 tabs.

13981 (ETDE/JP-mf–1759127, pp. 222-232) **Development of a highly efficient gasification process which control the ash melting temperature by adding the flux CaO.** Hirato, M. (Tokyo University of Agriculture and Technology, Tokyo (Japan). Faculty of Technology); Ninomiya, Y.; Lin, S. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

The present entrained bed gasifier gives priority to the fly ash content extraction, as required by the continuous operation, and operates at higher temperature than the optimized reaction temperature, which operational condition becomes a factor, to hinder the basic quantity of oxygen, wall life of gasifier and other points from the reliability and economical efficiency. Then, a series of experiments were made to design the lowering in temperature of the high temperature entrained bed gasification, by adding coal with flux and lowering fly ash content in melting temperature. $CaCo_3$, selected as flux, reacts with each content, upon having changed to CaO in the heightening process in temperature. The addition with CaO up to approx. 30% rapidly lowers each content in melting temperature down to 1200 to 1300 centigrade. If CaO surpasses 40% in quantity, the melting temperature rapidly heightens toward that of CaO, because CaO, contained in fly ash, approaches that of CaO. Therefore, the addition quantity with CaO as flux is up to 40% in fly ash. Through melting temperature controlling test of CaO by a small gasifier, coincidence was confirmed good between the simulated value and actually measured value. 4 refs., 15 figs., 3 tabs.

13982 (VTT-TUTK–703) **New alternatives for electricity production: Part 2. Comparision of gasification combined-cycle techniques for peat and wood.** Solantausta, Y. (Valtion Teknillinen Tutkimuslaitos, Espoo (Finland). Polttoainetekniikan laboratorio). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Aug 1990. 140p. (In Finnish). Order Number DE91763451. Source: OSTI; NTIS (US Sales Only).

The aim of the research work was to evaluate, on uniform grounds, the economic and technical potential of combined-cycle power plants fired with indigenous fuels (wood and peat). Four combined-cycle process concepts and one synthesis gas concept were studied: peat fluidized-bed oxygen gasification (electricity), peat fluidized-bed oxygen gasification (synthesis gas), peat fluidized-bed air gasification (electricity), wood fixed-bed gasification (combined electricity and heat), and wood flash pyrolysis (combined electricity and heat). Electricity can be produced at a high efficiency (43%, air gasification) with gasification combined-cycle technology. It is also possible to increase the effciency by optimizing the process concept. A construction ratio of 1.2 can be reached in combined electricity and district heat production. It is possible to increase the efficiency of electricity production from 41 to 44% (air gasification combined-cycle) by raising the inlet temperature to the gas turbine from 1 100 to 1 300 deg C. In electricity production, a higher efficiency and smaller production costs can be reached by peat fluidized-bed air gasification than by air gasification. However, peat oxygen gasification is a technically more advanded alternative than air gasification. In combined electricity and heat production an efficiency of 81% can be reached in the combined-cycle concept based on fixed-bed gasification. The pyrolysis concept did not prove competitive. The study indicated that a low level of emissions can be reached at competitive costs with gasification combined-cycle technology.

0105 Products and By-Products

Refer also to citation(s) 13986

13983 (DOE/MC/24266–2978) **Mild gasification technology development process: Task 3, Bench-scale char upgrading study, February 1988–November 1990.** Carty, R.H.; Onischak, M.; Babu, S.P.; Knight, R.A.; Wootten, J.M.; Duthie, R.G. Institute of Gas Technology, Chicago, IL (USA). Dec 1990. 51p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC21-87MC24266. Order Number DE91002058. Source: OSTI; NTIS; GPO Dep.

The overall objective of this program is to develop mild gasification technology and co-product utilization. The objective of Task 3 was to investigate the necessary steps for upgrading the mild gasification char into potential high-market-value solid products. Recommendations of the Task 1 market survey section formed the basis for selecting three value-added solid products from mild gasification char: form coke, smokeless fuel, and activated adsorbent

char. The formation and testing for the form coke co-product involved an evaluation of its briquette strength and reactivity. The measured tensile strength and reactivity of the form coke sample briquettes were in the range of commercial coke, and development tests on a larger scale are recommended. The reaction rate of the form coke carbon with carbon dioxide at 1825°F was measured using a standard procedure. A smokeless fuel briquette with limestone added to control sulfur can be made from mild gasification char in a simple manner. Test results have shown that briquettes with limestone have a heating value comparable to other solid fuels and the limestone can retain up to 88% of the sulfur during combustion in a simple bench-scale combustion test, almost all of it as a stable calcium sulfate. Adsorbent chars were prepared with a standard steam activation procedure and tested for a variety of pertinent property and performance values. Such adsorbents may be better suited for use in some areas, such as the adsorption of low-molecular-weight substances, because of the smaller pore sizes measured in the char. 5 refs., 17 figs., 6 tabs.

0106 Properties and Composition

Refer also to citation(s) 13936, 13942, 13959, 13962, 13974, 14018, 14019, 14021, 14762, 14776, 14779

13984 (DOE/MC/23075–2973) **Measurement and modeling of advanced coal conversion processes: Annual report, October 1988–September 1989.** Solomon, P.R.; Serio, M.A.; Hamblen, D.G.; Smoot, L.D.; Brewster, B.S. Advanced Fuel Research, Inc., East Hartford, CT (USA); Brigham Young Univ., Provo, UT (USA). Feb 1990. 310p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC21-86MC23075. Order Number DE91002046. Source: OSTI; NTIS; GPO Dep.

The objectives of this proposed study are to establish the mechanisms and rates of basic steps in coal conversion processes, to integrate and incorporate this information into comprehensive computer models for coal conversion processes, To evaluate these models and to apply them to gasification, mild gasification and combustion in heat engines. This report describes progress during the third year of the project. Specifically, the paper discusses progress in three task areas: (1) Submodel development and evaluation: coal to char chemistry submodel; fundamental high-pressure reaction rate data; secondary reaction of pyrolysis product and burnout submodels; ash physics and chemistry submodel; large particle submodels; large char particle oxidation at high pressures; and SO_x-NO_x submodel development and evaluation; (2) Comprehensive model development and evaluation: integration of advanced submodels into entrained-flow code, with evaluation and documentation; comprehensive fixed-bed modeling review, development evaluation and implementation; and generalized fuels feedstock submodel; and (3) Application of integrated codes: application of generalized pulverized coal comprehensive code and application of fixed-bed code. Individual reports have been prepared on these three tasks for inclusion on the data base.

13985 (DOE/MC/23075–2974) **Measurement and modeling of advanced coal conversion processes: Annual report, October 1989–September 1990.** Solomon, P.R. (Advanced Fuel Research, Inc., East Hartford, CT (USA)); Serio, M.A.; Hamblen, D.G.; Smoot, L.D.; Brewster, B.S. Advanced Fuel Research, Inc., East Hartford, CT (USA); Brigham Young Univ., Provo, UT (USA). Jan 1991. 224p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC21-86MC23075. Order Number DE91002056. Source: OSTI; NTIS; GPO Dep.

The objectives of this proposed study are to establish the mechanisms and rates of basic steps in coal conversion processes, to integrate and incorporate this information into comprehensive computer models for coal conversion processes, to evaluate these models and to apply them to gasification, mild gasification and combustion in heat engines. Progress is described during the fourth year of the study on the following tasks and subtasks: (1) Submodel development and evaluation: coal to char chemistry submodel; fundamental high-pressure reaction rate data; secondary reaction of pyrolysis product and burnout submodels; ash physics and chemistry submodel; large particle submodels; large char particle oxidation at high pressures; and SO_x-NO_x submodel development; (2) Comprehensive model development and evaluation: integration of advanced submodels into entrained-flow code, with evaluation and documentation; comprehensive fixed-bed modeling review, development evaluation and implementation; and generalized fuels feedstock submodel; and (3) Application of integrated codes: application of generalized pulverized coal comprehensive code; and application of fixed-bed code. Separate reports have been prepared for these three tasks for inclusion on the data base.

13986 (DOE/PC/88800–34) **Stable carbon isotope analysis of coprocessing materials: Quarterly technical progress report, January 1–March 31, 1990.** Lancet, M.S.; Winschel, R.A.; Burke, F.P. Consolidation Coal Co., Library, PA (USA). Jan 1991. 84p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-88PC88800. Order Number DE91008937. Source: OSTI; NTIS; GPO Dep.

Consol R & D is developing and demonstrating stable carbon isotope analysis as a method to quantitatively distinguish coal-derived and petroleum-derived carbon in products from coal/petroleum coprocessing. The approach taken is to develop the method, then demonstrate its application an authentic continuous-unit products. The experimental details used for stable carbon isotope analyses by the organization that performs most of those analyses under this contract are described. A method was developed previously under this contract to correct the carbon sourcing calculations performed from stable carbon isotope analyses for selective isotopic fractionation. The method relies on three assumptions. This quarter, a study was completed to define the sensitivity of the carbon sourcing results to errors in the assumptions. Carbon contents and carbon isotope ratios were determined for the available feeds and product fractions from HRI bench-scale coprocessing Run 238-10 (Texas lignite/Hondo vacuum still bottoms (VSB), Texas lignite/Cold Lake VSB and Westerholt coal/Cold Lake VSB). These data were used for carbon sourcing calculations and individual feedstock conversion calculations. A previously devised means for correcting for selective isotope fractionation was applied. 6 refs., 30 figs., 16 tabs.

13987 (DOE/PC/88924–9) **Thermodynamics of the solvent swelling of coal: Technical progress report No. 9, September 1, 1990–November 30, 1990.** Green, T.K. Western Kentucky Univ., Bowling Green, KY (USA). Center for Coal Science. [1990]. 22p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-88PC88924. Order Number DE91008355. Source: OSTI; NTIS; GPO Dep.

Sorption of pyridine by three Argonne premium coals was studied at 50°C and several relative vapor pressures. The pyridine-extracts, pyridine-insoluble residues and whole coals were all studied and compared. For the Illinois and Wyodak coals all sorption isotherms were linear with a nonzero intercepts. The results for these coals are interpreted in terms of a dual-mode sorption mechanism. At low pressures, we propose that pyridine concurrently fills holes and swells the coal material. At higher pressures, the holes are saturated and only swelling of the meterial occurs, which follows Henry's law. Swelling thus increases linearly with pressure of pyridine. The intercepts of the isotherms are interpreted as the amount of adsorbed pyridine. For both coals, the intercept of the isotherm for the pyridine-insoluble residue is two to three times that of the isotherm of the whole coal. This result is consistent with an increase in surface a upon extraction of the coal with pyridine. For the Pittsburgh #8 coal, the sorption isotherms for all three materials deviate from linearly, and the same dual-mode sorption mechanism cannot be confidently applied. The isotherm for the whole coal is curved with an apparent extrapolated intercept that intersects the origin. An interpretation of the isotherm is lacking at this time, but the result suggests a structural difference between the higher rank Pittsburgh #8 coal and the lower rank Illinois #6 and Wyodak coals. An analysis of the kinetics of pyridine sorption by the whole Illinois #6 and Wyodak coals reveals that both adsorption and swelling occur during the initial integral sorption experiment in which the pressure of pyridine is raised from zero to a relative pressure of 0.2. Swelling of the coal follows first-order kinetics. In subsequent incremental sorption experiments, the dominant sorption process is swelling with little or no net adsorption. 6 refs., 13 figs.

13988 (DOE/PC/89762–T2) **Thermodynamic model for calorimetric and phase coexistence properties of coal derived fluids: Annual report.** Kabadi, V.N. North Carolina Agricultural and Technical State Univ., Greensboro, NC (USA). Dept. of Chemical Engineering. 1 Oct 1990. 23p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89762. Order Number DE91008952. Source: OSTI; NTIS; GPO Dep.

On September 1, 1989 work was initiated on a project to extend the available vapor-liquid equilibrium (VLE) model for coal fluids to allow satisfactory predictions of excess enthalpies of coal liquids at high pressures. The current project involves measurement of some model compound VLE data and chromatographic characterization of coal liquids for distribution of heteroatoms. After one year, a thermodynamic model for VLE and excess enthalpies of defined mixtures of aromatic compounds has been developed. The model uses the modified UNIFAC correlation for the liquid phase. Some unavailable UNIFAC interactions parameters have been regressed from experimental VLE and excess enthalpy data. The model is successful in predicting binary VLE and excess enthalpy data. Some progress has been made on binary VLE measurements and size exclusion chromatography of coal liquids. 11 refs., 5 tabs.

13989 (DOE/PC/89764–T1) **Permeability changes in coal resulting from gas desorption: Annual report, August 16, 1989–August 15, 1990.** Levine, J.R.; Tsay, F.M. Alabama Univ., University, AL (USA). 12 Dec 1990. 19p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89764. Order Number DE91008484. Source: OSTI; NTIS; GPO Dep.

The principal objective of this research is to test the hypothesis that volumetric shrinkage of coal during desorption of occluded gases (particularly CH_4) can result in a net increase in permeability through natural fractures underground. This process may have important long-term implications regarding the producibility of natural gas from coal seam reservoirs. Coals having insufficient shrinkage will become self-sealing through time, while coals having sufficient shrinkage will develop progressively higher permeabilities. According to our original proposal, the testing of this hypothesis for a variety of US coal basins was to have encompassed 5 quasi-independent, interrelated topics: (1) Characterization of Coal Composition; (2) Mechanical Strength and Elasticity; (3) Sorption/Desorption Isotherms; (4) Determination of Volumetric Swelling and Shrinkage During Sorption/Desorption; and (5) Experimental Measurement of Specimen Permeability during Sorption and Desorption. The research is also aimed at providing an improved understanding of gas sorption in coal and its relationship to coal composition. Information on swelling during sorption may find additional applicability in solvent swelling studies of coal, which may be important in deep cleaning of organic sulfur and other contaminant elements of in coal conversion technologies. An additional benefit will be development of microgravimetric sorption techniques for methane at high pressure. A summary of the activities of each task is given. 4 figs.

13990 (DOE/PC/89764–T2) **Permeability changes in coal resulting from gas desorption: Fifth quarterly report, August 15, 1990–November 15, 1990.** Levine, J.R.; Tsay, F. Alabama Univ., University, AL (USA). Dept. of Mineral Engineering. 23 Dec 1990. 24p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89764. Order Number DE91008487. Source: OSTI; NTIS; GPO Dep.

The project objective is to test the hypothesis that the desorption of gases (particularly methane) from coal results in shrinkage of the coal matrix, bringing about a net increase in permeability. This project is currently focused on 3 component tasks: (1) Sample Collection, Specimen Preparation, and Compositional Characterization; (2) Determination of Sorption/Desorption Isotherms; and (3) Experimental Measurement of Swelling and Shrinkage of Coal Specimens during Sorption and Desorption. Specimens were prepared for sorption isotherm and sorption strain experiments. The paper concentrates on describing specimen preparation, the affixing of strain gages, and preliminary results from initial sorption strain experiments. The paper contains two appendices: Coal volumetric strains due to pressure and CO_2 adsorption and Gas sorption measurements with a microbalance. 3 refs., 5 figs.

13991 (DOE/PC/89790–5) **Chemistry of coal-related microparticles: [Quarterly progress report], September 1, 1990–November 30, 1990.** Davis, E.J.; Krieger-Brockett, B. Washington Univ., Seattle, WA (USA). Dept. of Chemical Engineering. [1990]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89790. Order Number DE91008451. Source: OSTI; NTIS; GPO Dep.

This research project involves the study of the coal macerals and sorbent microparticles used to remove SO_2 and/or H_2S from process streams. To measure reaction rates a charged single microparticle is held electrodynamically in one or more laser beams by superposed ac and dc electrical fields. The use of the electrodynamic balance for microparticle studies was pioneered by one the principal investigators. One of the laser beams is used for light-scattering measurements to determine the particle size and to provide the excitation source for obtaining Raman spectra to chemically characterize the particle. The other beam, an infrared beam, is used to heat the particle electromagnetically. The first year of the research was devoted to preliminary experimental work and design studies. Although components and techniques must still be developed, experimental measurements on single macerals are now being done in this laboratory. 1 fig.

13992 (DOE/PC/89793–T2) **Undergraduate research studies program at participating institutions of the HBCU Fossil Energy Consortium: Quarterly report, September 30, 1989–December 29, 1989.** Bhatia, S.C.; Cardelino, B.H.; Hall, J.H. Jr.; Mitchell, M.B.; Stelson, A.W. Atlanta Univ. Center, Inc., GA (USA). Dolphus E. Milligan Science Research Inst. 31 Jan 1990. 45p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89793. Order Number DE91008944. Source: OSTI; NTIS; GPO Dep.

This report consists of five quarterly progress reports from four participating universities. The titles of the projects are: Competition of NO and SO_2 for OH generated within electrical aerosol analyzers; Dispersed iron catalysts for coal gasification; Catalytic gasification of coal chars by potassium sulfate and ferrous sulfate mixtures; Removal of certain toxic heavy metal ions in coal conversion process wastewaters; and Study of coal liquefaction catalysts. All reports have been indexed separately for inclusion on the data base. (CK)

13993 (ETDE/JP-mf–1759127, pp. 216-221) **Maceral analysis of coals for liquefaction by means of image processing.** Okada, K. (The Coal Mining Research Center, Tokyo (Japan)); Kanbayashi, Y. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

The coal liquefaction, as low in reaction temperature, is very strongly influenced by maceral content and coal rank. Therefore in order to investigate in detail the relation between the liquefying reaction and coal structure, analysis was made at maceral type stages. In the present report, the maceral was classified into four groups of type, i.e., exinite, vitrinite B, vitrinite A and inertinite, and method was explained, upon elucidation of each group of type in image characteristics, to determine their quantitative ratio by the image analysis. The four types being discriminated, their gray value (gradation where black and white are 0 and 255, respectively) was measured. Each type was calculated in mean gray value, mean standard deviation and mean variation coefficient, which were taken as image characteristics. Quantitative ratio, obtained by the image analysis, based on the image characteristics of individual maceral type, with use of Paintearth coal, Canada, was compared to coincide, extremely well, with that of conventional structure analysis result. 8 figs., 2 tabs.

0108 Waste Management

Refer also to citation(s) 13952, 13953, 13991, 13992, 14026, 14044, 14045, 14195, 14484, 14485, 14489, 14490, 14491, 14492, 14493, 14494, 14495, 14496, 15259

13994 (CONF-8510287–2) **Characterization of KILnGAS process condensate.** Walker, J.F. Jr.; Brown, C.H. Jr.; Fisher, J.F. Oak Ridge National Lab., TN (USA). [1985]. 10p. Sponsored by Electric Power Research Inst., Palo Alto, CA (USA). DOE Contract AC05-84OR21400. Contract RP2526-2. From 5. EPRI contractors' conference on coal gasification; Palo Alto, CA (USA); 30-31 Oct 1985. Order Number DE91009648. Source: OSTI; NTIS; GPO Dep.

In recent years, a great deal of development work has been done on processes and hardware directly related to coal gasification. These gasification processes produce wastewaters containing varying amounts of dissolved organics, ammonia, and other contaminants. Samples of process condensate obtained from the 600-tpd KILnGAS demonstration unit at Alton, Illinois, were obtained during plant operation in November and December of 1984. The samples were preserved and sent to Oak Ridge National Laboratory (ORNL) in Oak Ridge, Tennessee, where they were subjected to detailed characterization. The results of these analyses indicate that the KILnGAS process condensate is similar to many other gasification wastewaters. Subject to experimental verification, these results indicate that KILnGAS process condensate treatment should be possible by conventional technology. 1 fig., 4 tabs.

13995 (DOE/METC–91/0273) **Gas stream cleanup: Technology status report.** Bossart, S.J.; Cicero, D.C.; Zeh, C.M.; Bedick, R.C. USDOE Morgantown Energy Technology Center, WV (USA). Aug 1990. 66p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91002037. Source: OSTI; NTIS; GPO Dep.

This report describes the current status and recent accomplishments of gas stream cleanup (GSCU) projects sponsored by the Morgantown Energy Technology Center (METC) of the US Department of Energy (DOE). The primary goal of the Gas Stream Cleanup Program is to develop contaminant control strategies that meet environmental regulations and protect equipment in advanced coal conversion systems. Contaminant control systems are being developed for integration into seven advanced coal conversion processes: Pressurized fludized-bed combustion (PFBC), Direct coal-fueled turbine (DCFT), Intergrated gasification combined-cycle (IGCC), Gasification/molten carbonate fuel cell (MCFC), Gasification/solid oxide fuel cell (SOFC), Coal-fueled diesel (CFD), and Mild gasification (MG). These advanced coal conversion systems present a significant challenge for development of contaminant control systems because they generate multi-contaminant gas streams at high-pressures and high temperatures. Each of the seven advanced coal conversion systems incorporates distinct contaminant control strategies because each has different contaminant tolerance limits and operating conditions. 59 refs., 17 figs., 5 tabs.

13996 (DOE/PC/79929–11) **NO_x-char reactions: Kinetics and transport aspects: Quarterly technical progress report, July 1, 1990–September 30, 1990.** Calo, J.M.; Suuberg, E.M.; Teng, H.; Milosavljevic, I.D. Brown Univ., Providence, RI (USA). Div. of Engineering. [1990]. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-87PC79929. Order Number DE91008953. Source: OSTI; NTIS; GPO Dep.

The principal goal of this project is to develop a mechanistic understanding of the processes by which carbons reduce NO to N_2. The reaction of interest may be represented by the non-stoichiometric equation: $C + NO \rightarrow CO, CO_2, N_2$. The relative yields of CO and CO_2 depend upon the reaction conditions, as will be described below. The carbon selected for study in this program was a char derived from phenol-formaldehyde resin. This material has been noted to be a reasonable model for coal chars in most respects, except that its gasification behavior is not complicated by catalytic processes due to minerals. For a fundamental study such as this, the absence of catalytic effects is important. In addition to its being a reasonable model for coal chars, the phenol-formaldehyde resin chars also have the advantage that they have been extensively studied with respect to gasification in oxygen and CO_2. In the first phases of the project, the global kinetics of the process were established. In more recent work, attention has been turned to the individual steps in the mechanism. Recent quarterly reports have detailed the role of both chemisorption and desorption processes in determining the course and kinetics of the process. This report continues the reporting of results obtained along these lines, and draws an important new conclusion concerning the number of separate processes involved in determining the kinetics. 11 refs., 10 figs.

13997 (DOE/PC/88874–T12) **Theoretical approach for enhanced mass transfer effects in-duct flue gas desulfurization processes: Quarterly report No. 10, October 1, 1990–December 31, 1990.** Acurex Corp., Research Triangle Park, NC (USA). Environmental Systems Div.; Texas Univ., Austin, TX (USA). Dept. of Chemical Engineering. 21 Jan 1991. 34p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-88PC88874. Order Number DE91009505. Source: OSTI; NTIS; GPO Dep.

During the reporting period of October 1 to December 31, 1990, bench-scale experiments were conducted to measure mass transfer and kinetic rates under simulated duct injection conditions. Section 2 describes the results of the stirred tank experiments that were conducted to determine the effect of acetic acid on SO_2 absorption. These experiments, which were performed over a range of liquid agitation and SO_2 concentration, demonstrated that acetic acid was effective in enhancing SO_2 absorption in the slurry injection process, if SO_2 absorption was controlled significantly by liquid film resistance. Section 3 presents the results of experiments with moist solids in the short time differential reactor (STDR). Solids with specific surface areas,ranging from 6.9-47.1 m^2/g, were tested. The maximum conversion that was measured for any particular sorbent occurred for an optimum initial free moisture content. The amount of maximum conversion increased as sorbent surface area increased. The effects of the approach to saturation on a sorbents reactivity varied according to the initial free moisture content of the sorbent. Section 4 summarizes the work that has been done to quantify the ability of lime/fly ash solids to carry moisture. Critical moisture, as determined by sieving tests, of a variety of calcium silicate solids correlated well with surface area over a range of 9-128 m^2/g. The presence of $CaSO_3 \cdot 1/2H_2O$ and $CaSO_4 \cdot 2H_2O$ in the slurries at amounts reasonable for recycle operations did not affect the critical moisture correlation. 11 figs., 8 tabs.

13998 (DOE/PC/89659–T2) **Coal reburning for cyclone boiler NO_x control demonstration: Quarterly report No. 2, July–September 1990.** Babcock and Wilcox Co., Cassville, WI (USA). [1990]. 42p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC22-90PC89659. Order Number DE91008948. Source: OSTI; NTIS; GPO Dep.

The subject of this report identifies progress for Phase I – Design and Permitting and Phase IIA – Long Lead-Time Item Procurement. Under Phase I, the following activities are discussed. Task 1 – Management and Reporting included completing the Project Work Plan, the Project Evaluation Plan, and the Environmental Monitoring Plan. Under Task 2 – Pilot-Scale Cyclone Boiler Tests, reporting the results from the second coal tested, a high sulfur Illinois coal, is summarized in this document. These data, both baseline and reburning results, will broaden the technological basis for commercialization of the technology. Activities in Task 3 – Numerical and Physical Flow Modeling concentrated on completing their subtasks in order to provide reburn system design recommendations. Discussions pertaining to the modeling methodology is included in this report. The Baseline Characterization Test Report – Task 4 continues in the preparation stage due to the concentrated effort in the reburn system design phase. For Task 5 – Design of the Reburn System, general arrangement drawings were completed in order to allow detailed activities to commence. The reburn burner/OFA port designs are nearing completion and should be finalized within the next quarterly report. Finally, Task 6 – Permitting Activities continue. The major components of this document include the results of the high sulfur coal pilot scale tests, the numerical/physical flow modeling recommendations, additional Nelson Dewey No. 2 baseline test data, and a summary of the overall reburn system design. The reburn system design involves input from all the project's tasks and thus, this document assembles a summary of the tasks performed to date with the culmination being the proposed reburn system design. 14 figs., 4 tabs.

13999 (DOE/PC/89807–T2) **An evaluation of a pre-charging pulse-jet filter for small combustor particulate control: Project quarterly report, March–May 1990.** Quimby, J.M. Cottrell Environmental Sciences, Somerville, NJ (USA). Jul 1990. 13p. Sponsored

by USDOE, Washington, DC (USA). DOE Contract AC22-89PC89807. Order Number DE91008942. Source: OSTI; NTIS; GPO Dep.

The objective of this test program is the performance and economic evaluation of a pre charged-pulse jet filter as the principal particulate control device for a commercial or industrial scale coal fired combustor. Performance factors that will be considered are the effects of particle charge, air/cloth ratio, fabric types, percent humidity and inlet particulate loading on fine particle collection efficiency, and pressure drop. Economic factors that will be considered are capital costs, energy and other operating costs, and maintenance costs. The program will result in a recommendation regarding the relative suitability of the pre charged pulse-jet filter for small combustor particulate control, as compared to other control devices. Fine particle control capability, ease of operation, and overall economics will be taken into consideration in making comparisons. Test system erection has been completed. Shakedown of the system components has started and several minor problems were discovered but easily resolved. Shakedown is expected to be completed in June. The test program is expected to get underway in July. A work plan schedule of test events is attached in Appendix B with each run lasting 24 hours.

14000 (DOE/PC/90176–T13) **Evaluation of sulfur-reducing microorganisms for organic desulfurization: Quarterly technical report, September 1, 1990–November 30, 1990.** Miller, K.W. (Illinois State Univ., Normal, IL (USA). Dept. of Biological Sciences). Illinois Dept. of Energy and Natural Resources, Springfield, IL (USA). [1990]. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-90PC90176. Order Number DE91010512. Source: OSTI; NTIS; GPO Dep.

Because a substantial portion of the sulfur in Illinois coal is organically bound sulfur, microbial desulfurization of sulfidic and thiophenic functionalities holds great potential for complementing pyritic sulfur removal. The principal goals of their project are: to obtain anaerobic microbial cultures that produce H_2S from compounds representative of the organosulfur functionalities in coal; to optimize this activity; to evaluate the effectiveness of using these cultures to remove organic sulfur from Illinois coal. Their immediate objectives for this year are the following: to obtain additional cultures from coal mine waste and municipal sewage sludge, two environments previously unexplored by their laboratory; to continue optimizing activity in cultures that desulfurize model compounds, including identification of individual microbial species; to expand coal desulfurization experiments to include additional coals; and, to address the recently discovered problem of sulfide sorbing to coal. This quarter they installed a Coy Anaerobic Chamber, which will be used for isolation and manipulation of anaerobic cultures. Additionally, the anoxic atmosphere within the chamber makes it an ideal location for grinding and sieving a sample of North Dakota lignite and IBC-101, both of which will be used in desulfurization and sulfide sorption experiments. Further experiments with mixed anaerobic cultures that reductively degrade dibenzyldisulfide (DBDS) have demonstrated that reduction of DBDS does not depend on co-reduction of sulfate. 34 refs., 1 fig., 2 tab.

14001 (DOE/PC/90309–1) **Anion-exchange resin-based desulfurization process: Quarterly technical progress report, August 9, 1990–December 31, 1990.** Sheth, A.C.; Strevel, S.D. Tennessee Univ., Tullahoma, TN (USA). Space Inst. [1990]. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-90PC90309. Order Number DE91008450. Source: OSTI; NTIS; GPO Dep.

Under the current grant, The University of Tennessee Space Institute (UTSI) will carry out the bench scale evaluation and further development of the anion-exchange resin-based desulfurization concept to desulfurize alkali metal sulfates. This concept has been developed and patented by UTSI. The technical feasibility of this concept has been demonstrated and reported in the M.S. theses prepared by Butler and Modeste. Under the present DOE grant, with the aid of a graduate student, we plan to screen commercially available resins, and then select three resins for further process variables study and improving resin performance. From this process variables study, we plan to select one resin which we will use in optimizing the resin regeneration step and to evaluate the effect of various performance enhancers. Results of the bench scale study will then be incorporated into an improved process concept/schematic, which will then be utilized in developing related process economics. We plan to carry out the bench scale evaluation using reagent grade chemicals as well as representative spent seed (from a coal-fired magnetohydrodynamics-MHD system) and/or spent sorbent material (from an in-duct sorbent injection system using a sodium based sorbent) if available. 3 refs., 2 figs.

14002 (ECN-C–90-051) **High temperature gas cleaning system study: Substudy 2.3: Alkali metals and other trace elements.** Alderliesten, P.T. Netherlands Energy Research Foundation, Petten (Netherlands). Nov 1990. 37p. (In Dutch). Contract NOVEM 22630/61/04. Order Number DE91760564. Source: OSTI; NTIS (US Sales Only).

The state-of-the-art with respect to the knowledge on the behavior of alkali metals and other volatile trace elements in entrained-bed coal gasification systems is summarized. Gas turbine and environmental requirements were reviewed. Based on scarce literature data the maximum gas-phase concentrations at the outlet of the gasifier were estimated. Further, assuming specific chemical speciation of the elements, the major parameters influencing gas-phase concentrations at three temperature levels relevant to this study (600, 350 and 250 C), i.e. the inlet temperatures of the high temperature gas cleaning system, were evaluated qualitatively. Conclusions are drawn with regard to the necessity of the removal of alkali metals and other volatile trace elements when high temperature gas cleaning will be applied, with regard to the lead and zinc concentrations in gaseous turbine fuels, with regard to the commercialization period of removal processes for gaseous alkali metals and finally, with regard to the difference between trace elements of an IGCC with a dry high temperature gas cleaning system and the emissions of a conventional pulverized coal combustion system equipped with FGD. 36 refs., 6 tabs., 3 apps.

14003 (ETDE/JP-mf–1759127, pp. 124-133) **Present state and outlook for utilization of coal ash.** Miwa, T. (The Coal Mining Research Center, Tokyo (Japan)); Yasuda, M.; Niimura, T.; Iizawa, M.; Shimada, Y. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper described the present state and outlook of coal ash utilization. Annual generation of coal ash is about 4 milion tons from the electric power industry and about 1.5 million tons from other industries. Fly ash (FA) can generate from any types of boiler but bottom ash (BA) is generated from the stoker firing boilers and fine coal firing boilers but not from fluidized bed boilers. Properties of ash depend on coal kinds and types of combustor, and especially the ash generated from any fine coal firing boilers is fused and glassified in many cases because of higher combustion temperature. Unfused ash can generate from coal containing ash of higher melting point and from low temperature combustion to reduce NO_x. Concerning the utilization of ash generated by fine coal combustion, FA is used as the cement admixture and BA is used as the base cource material, and small amount is used as the filler for asphalt and as the block material. The ratio of foreign coal may increase in future and the main application is the fine coal combustion, so that large amount of ash of unburnt ratio of 2-12%, and coke-like or partially molton or perfectly molton spherical ash may generate and the effective utilization may be difficult. If recoverable, FA and BA can be used widely. 7 refs., 3 figs., 7 tabs.

14004 (ETDE/JP-mf–1759127, pp. 134-142) **R and D on coal ash utilization.** Miwa, T. (The Coal Mining Research Center, Tokyo (Japan)); Yasuda, M.; Niimura, T.; Iizawa, M.; Shimada, Y. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper examined the rationalization of storage and handling important to promote the effective use of coal ash. Even if coal ash is stored at a wet condition, the properties do not deteriorate after 3 months but compressive strength, etc. are rather improved. Even if

coal ash was exposed to the weather for 8 years, the deterioration was slight. Fly ash may be exposed in the weather only by sheets or lining even for a work where a large amount of coal ash is used as the admixture, so that large saving may be permitted. The fly ash-cement mixture which is prepared by adding cement (3%) and water to fly ash has superior fluidity and strength and can place to an underwater face of slope without large scale of forms and can use in place of conventional soil as the counterweight fill of impervious sheets for a revetment locating in the marine ash dump. The mixture does not affect seawater and environment. When coal ash and an organic substance are compounded to cement or gypsum as a binder, pellets of hardness which are suitable for a soil conditioner, can be manufactured and further, soil can be improved by the multiplier effect of coal ash and the organic substance so as to promote the growth of plants. 3 refs., 8 figs., 11 tabs.

14005 (ETDE/JP-mf–1759127, pp. 143-151) **Utilization tests of fly ash stabilized by Poz-o-Tec system.** Miwa, T. (The Coal Mining Research Center, Tokyo (Japan)); Kido, S.; Kuwabara, T. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

In the present study, demonstration test was made on technology to promote the pozzolan reaction, by adding fly ash with desulfurization sludge, produced from the stack gas desulfurization process in the thermal power station, and then mixing it with lime (the mixture is called Poz-o-Tec.). That test was continued for a period of three years. In the first term of year, basic mixture test was made on domestic fly ash. In the second term of year, pursuit survey was made by, as a a basic on-site test, producing Poz-o-Tec, and filling land and structuring roadway subgrade with it by general purpose heavy equipment in the station. In the third term of year, usability survey was commenced with using a practical use scale plant, supplying material and constructing actual public roadway with it. While simultaneously, aptitude test was made as water-barrier landfill material, to stop water from landfilled bank and water reservoir, and surface soil-improving material for the soft ground. As a result of those serial tests, the Poz-o-Tec was known to give a high possibility of being commercialized as civil construction use material. 20 figs., 12 tabs.

14006 (ETDE/JP-mf–1759127, pp. 192-200) **Fundamental tests on recovery of valuable matters from coal ash. I.: Recovery of magnetite from coal ash by a high gradient magnetic separator.** Murakami, T. (The Coal Mining Research Center, Tokyo (Japan)). Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

For the purpose of recovering fly ash magnetite (FAM), contained in fly ash (FA), FAM recovery plant for the practical use was made in conceptual design, technical evaluation and economic evaluation, based on test result of two methods, ie., wet HGMS (high gradient magnetic separation)-wet LIMS (low intensity magnetic separation) and dry HGMS-wet LIMS. The conceptual design was to treat FA, 50000ton in annual quantity, and recover FAM, 7800ton and 4000ton by the wet HGMS (W method) and dry HGMS (D method), respectively. In cost per ton, FAM product was Yen 18178 and Yen 38852 by the W method and D method, respectively. The FAM can be used also as dense medium for the dense medium cleaning in the coal preparation plant. By the W method, it gives, as almost equivalent in actual selling price to the dense medium, a possibility to be put to practical use. However, because the produced quantity of FAM, also as estimated by the present study, surpasses the demand of dense medium for the coal preparation use in Japan, the FAM recovery is indispensable in purpose development of use. 2 refs., 3 figs., 6 tabs.

14007 (ETDE/JP-mf–1759127, pp. 201-208) **Fundamental tests on recovery of valuable matters from coal ash. II.: Direct hydrofluoric acid leach process.** Kumamoto, J. (Kobe Steel, Ltd., Kobe (Japan)). Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

As a recovery method of valuable content in fly ash upon the chemical treatment, study was made of direct hydrofluoric acid leach process which is an acid leach method to use mixed acid of fluoric acid and hydrochloric acid. In order to study the purpose of use of dissolution residue and recovered matter, based on the result of test and research, so far made, test was made on synthesis of silicon carbide and produced condition of micro-granular SiO_2, and both technical and economic evaluations were further done of practical use plant. At 3 to 4 in mole C/SiO_2 ratio, silicon carbide being produced with a good synthetic ratio, residue was indicated to give a possibility of being effectively utilized. In order to micro-granulate SiO_2 grain, it is effective to lower the concentration of Si in the solution or heighten the temperature of solution. In each of both the cases, obtainment was made of micro-granular grain, 0.01 to 0.04 microns in size. As a result of evaluating the practical use plant in economicality, profitability was not indicated to be good against the product price, calculated from the present market scale of silica. 3 refs., 11 figs.

14008 (ETDE/JP-mf–1759127, pp. 209-215) **Fundamental tests on recovery of valuable matters from coal ash. III.: Calsinter method.** Nakamura, T. (Onoda Cement Co. Ltd., Yamaguchi (Japan)); Sasaki, Y. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

In relation with the valuable matter recovery from fly ash by the calsinter method, technical and economic evaluation was made through conducting the conceptual design and marketability investigation. The calsinter method is to flake-form fly ash, after having been simultaneously mixed with line stone and quick line, and crushed, and calsinter it by sintering it by kiln. Valuable matter is eluded by taking crushed calsinter clinker as raw material and 4N sulfuric acid liquid in an acid elusion tank, and heating them by steam up to 98 centigrade. Eluded liquid, through being separation-operated, is recovered as SiO_2, $CaSO_4$ and Al_2O_3. The calsinter, without being influenced by the category of fly ash, can give a high elusion ratio of valuable matter (Al, Fe and Ti). However, because expensive agent is used to separate and recover valuable content, eluded by sulfuric acid, the production cost was so extremely higher than the market price for product that the feasibility study did not result in its profitability. 1 fig., 2 tabs.

14009 (ETDE-mf–1764594) **Treatment of residue from power plants as an environmental protection measure - hard coal fly ash. Final report on preliminary phase.** Kautz, K.; Lorson, H. GFR mbH, Iphofen (Germany, F.R.); Noell GmbH, Wuerzburg (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). [1990] 155p. (In German). Contract BMFT 144 0529 I. Order Number DE91764594. Source: OSTI; NTIS (US Sales Only).

According to the Federal Law for the Protection of the Environment residue from lignite and hard coal-fired power stations must be further processed, to as great an extent as possible. The process which is the subject of this report is directed towards those types of fly ash which cannot be directly used for industrial purposes. A preliminary phase of a plan for the treatment of fly ash was prepared on the basis of comprehensive surveys of the filler material treatment industry, chemical-physical analyses and experiments on the treatment of fly ash. The main emphasis of the investigations is on the manufacture of fly ash subproducts, which are comparable to conventional raw materials in quality. (orig.) With 25 refs.; 33 tabs.; 16 figs.

14010 (IVO-B–06/90) **Leachate chemistry of coal fly ash and FGD- (Flue Gas Desulphurization) products and the research methods of the leaching rates - literature survey.** Koistinen, J. Imatran Voima Oy (IVO), Helsinki (Finland). 1990. 87p. (In Finnish). Order Number DE91763448. Source: OSTI; NTIS (US Sales Only).

This report presents a literature-based survey on weatherd fly ash and FGD- (Flue Gas Desulphurization)-product leachate chemistry and evolution of leachate chemistry with time in the disposal environments, such as landfills. The main principles and methods in predicting elemental concentrations, elemental distributions and rates of elemental extraction in the leachate, are presented. The research aims to enlighten the leaching phenomenon, different leaching mechanisms and factors controlling the leaching.

0109 Environmental Aspects

Refer also to citation(s) 14498, 14701, 14742, 14748, 14756, 15261, 15276, 15310, 15311, 15313, 15314, 15315, 15316, 15317, 15318, 15319, 15320, 15321

14011 (ETDE/JP-mf–1759127, pp. 1-35) **Future prospects of coal policy and R and D activities.** Nei, H. (Agency of Natural Resources and Energy, Tokyo (Japan)). Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Resarch Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper described the coal policy and researching and developing activities in the global environmental problem. The emission of CO_2 can be reduced by 15% if the thermal efficiency could be raised from 37% to 43%. For this reason, small and medium sized equipments for atmospheric fludized bed combustion are partially used practically and a demonstration plant of 50,000kW class is being developed. The development of a pressurized fluidized combined cycle power generation was started to reduce the CO_2 emission by 12% through raising the thermal efficiency from 37% to 42%. Research and development of a pilot plant is similarly carried out on the entrained bed gasifying combined power generation. Some low pollution techniques such as the wet type flue gas desulfurization, the catalytic reduction type flue gas denitrification and multi-stage combustion methods are practically used. Development of a simultaneous dry type compact desulfurizing and denitrificating technique by using active carbon advances to the considerable stage. Some techniques such as convenient use of coal by CCS (coal cartridge system) and CWM (coal water mixture) or effective using tecnique of coal ash are developed to practically promote the coal utilization.

0110 Reserves, Geology, and Exploration

14012 (LA–11889-MS-Vol.2) **The peats of Costa Rica: Volume 2, Resource assessment.** Obando A, L. (RECOPE, San Jose (Costa Rica)); Malavassi R, L.; Ramirez E, O.; Cohen, A.; Raymond, R. Jr.; Thayer, G.R. Los Alamos National Lab., NM (USA). Apr 1991. 34p. Sponsored by Agency for International Development, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91009768. Source: OSTI; NTIS; GPO Dep.

The objectives of this investigation were: (1) to locate potential peat deposits in Costa Rica; (2) to estimate as closely as possible by representative sampling the amount of peat present in each deposit, and (3) to make a preliminary evaluation of the quality of the peat in each deposit. With information from soil maps and a 3-week survey of Costa Rica, it is estimated that a potential area of about 1000 km^2 is covered by peat. Most of the peat area (about 830 km^2) is in northeastern Costa Rica in the Tortuguero area. An aerial survey identified the potential peat areas by the exclusive presence of the Yolillo palm. The next largest potential area of peat (about 175 km^2) is in the cloud-covered areas of the Talamanca Mountains. Some reconnaissance has been done in the Talamanca Mountains, and samples of the peat indicate that it is very similar to the sphagnum peat moss found in Canada and the northern US. Smaller bogs have been discovered at Medio Queso, El Cairo, Moin, and the Limon airport. Two bogs of immediate interest are Medio Queso and El Cairo. The Medio Queso bog has been extensively sampled and contains about 182,000 metric tons (dry) of highly decomposed peat, which is being used as a carrier for nitrogen-fixing bacteria. The El Cairo bog is sparsely sampled and contains about 1,300,000 metric tons of slightly decomposed dry peat. Plans are to use this peat in horticultural applications on nearby farms. 10 refs., 11 figs., 7 tabs.

0120 Mining

Refer also to citation(s) 14049, 14050, 14375

14013 (ETDE/JP-mf–1759127, pp. 36-45) **Technical progress of coal mining engineering.** Watanabe, Y. (Hokkaido University, Sapporo (Japan). Faculty of Engineering). Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper described technical progress of the mining engineering. Road heading was mainly made by blasting and the rock drill for blasting was converted to the oil hydraulic type to result in higher efficiency and lower noise. Loading operation was mechanized to 99% and popularly conducted by side tipping loaders. Some oil hydraulic road headers are recently used for drifting in rock. Roof supporting work to maintain tunnels is also mechanized and concrete spraying is also used. Many working faces for coal mining were self advanced and shielding frame was introduced, so that the perfect mechanization and highly efficient mining could be realized by combining these with drum cutters. Safe and unmanned remote controlling work advances to prevent workers from troubles such as gas outburst and rock burst. High pressure hydraulic coal mining was developed owing to the high productivity and remote controllability but disappeared now with closing many mines. Coal transporting technique advances rapidly with the advance of belt conveyors and unmanned work is also conducted. Hydraulic transportation from deep coal mine was put into practical use. The average productivity of workers in working faces rose from 3 t/shift of 30 years ago to today ' s 30 t/shift, exactly by 10 times. 5 refs., 12 figs.

14014 (ETDE/JP-mf–1759127, pp. 46-48) **Present study for coal mining production.** Fujise, T. (The Coal Mining Research Center, Tokyo (Japan)). Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Resarch Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper described the research and development for coal mining production. Vertical shafts or inclined shafts are opened, and tunnels are excavated to reach from a ground surface to coal seams and to make working faces. Fields divided by excavation are road headed and mined by combining cutters, self advancing supports and conveyors. A remote controlling equipment distant from a working face is now developed especially to automatize mining for a slowly inclined coal seam and to aim the mass mining. Cutters are either the conveyor loading type, semi-loading type or ground skidding type; and an automatic valve which can be controlled by one touch operation was equipped for the self advancing support. Transfer of stage loader, expansion or contraction of belt conveyor accompanied by the transfer and swing at the working face were automatized. A system was adopted to enable remote monitoring to get information for the drum cutters, self advancing frames and working face. In addition, a system in which supports can automatically follow from the rear side after cutting by the cutters, is being developed. Since the efficiency is limited for road heading by blasting, a road header was trially fabricated and tested in a working face. 3 figs.

14015 (EUR–12651) **Development of instrumentation for guided long-hole drilling: Final report.** Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; British Coal Corp., Burton-on-Trent (UK). 1990. 255p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract 7220-AB/813. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

Guided long-hole drilling (GLHD) is a relatively new exploration technique which has an important role to play in minimising geological risks in coal mining. The technique requires the use of survey probes to determine the trajectory of an in-seam drilled borehole and its position with respect to the coal seam boundaries. Prototype borehole radar and acoustic systems have been developed and used in models and at an opencast site. They have been operated in both transmission and reflection modes, although attenuation in surface coal was found to be severe in much of the seam and it was not expected that any clear target identification would be obtained. Equipment to enable underground radar and acoustic measurements is now substantially complete and the first transmission trials in deep coal are expected during 1989. Where material properties and noise levels prove promising, trials will be extended to reflection studies and subsequently to the incorporation and optimisation of transducers within the steel drill string. These trails will be accompanied by the development and implementation of any necessary signal processing. 95 refs., 97 figs., 2 tabs.

0130 Transport, Handling, and Storage

14016 (DOE/CE/15466–T1) **Coal-log pipeline system development: Quarterly report No. 1, August 24, 1990–November 24, 1990.** Missouri Univ., Columbia, MO (USA). Dept. of Civil Engineering. [1990]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-90CE15466. Order Number DE91009812. Source: OSTI; NTIS; GPO Dep.

The objective of this study is to demonstrate that the amount of binder in coal logs can be reduced to 8% or below to produce logs with adequate strength to eliminate breakage during pipeline transportation under conditions experienced in long distance pipeline system. In addition the study will perform the necessary development to demonstrate a small model of the most promising injection system for coal-logs; test the logs from Task 1; conduct economic analysis of coal-log pipeline, based upon the work to date; and refine and complete the economic model. A detailed literature search in coal agglomeration has been conducted. This includes all the known previous attempts to agglomerate coal. Some important findings are listed. Some very preliminary tests have been done on making coal logs with and without binder. A small-scale demonstration unit of a coal log pipeline (CLP) has been designed. It uses 1 1/4-inch transparent plastic pipe and the loop is approximately 128 feet in length. The design is shown in a figure; construction has not begun as yet. 1 fig.

14017 (DOE/PC/79880–T1) **Sulfur and mineral matter reduction in coal using selective agglomeration: First quarterly technical report, October 1, 1987–December 31, 1987.** Simmons, F.J.; Keller, D.V. Jr. OTISCA Industries Ltd., Syracuse, NY (USA). Dec 1987. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-87PC79880. Order Number DE91009895. Source: OSTI; NTIS; GPO Dep.

Presented herein is the first quarterly technical report for the DOE/PETC-sponsored project entitled Sulfur and Mineral Matter Reduction in Coal Using Selective Agglomeration. The major project objective is to evaluate the ability of selective agglomeration to reject pyrite as a function of raw coal handling, storage and aging. The project involves the collection of freshly mined samples of four eastern bituminous coals at the mine and transporting these coals to Otisca's Syracuse, New York Lab for testing. Each of the four coals (approx. 1 ton) were divided at the mine into three groups. Group-1 (approx. 0.5 tons) was stored in 55-gallon drums purged with nitrogen. Group-2 (approx. 0.25 tons) was stored in drums and covered with mine-site tap water, while Group-3 (approx. 0.25 tons) was stored in drums under a normal atmosphere. By this procedure the authors will insure the availability of fresh raw coal samples for all phases of testing. They will also be able to closely monitor the aging of all four coals from a known starting pint with respect to the various handling and storage procedures used. This report describes the handling and size reduction to which the coals were subjected, and lists results on the preliminary analyses done on the four coals. 1 fig., 2 tab.

14018 (DOE/PC/79880–T4) **Sulfur and mineral matter reduction in coal using selective agglomeration: Fourth quarterly technical report, July 1, 1988–September 30, 1988.** Simmons, F.J.; Keller, D.V. Jr. OTISCA Industries Ltd., Syracuse, NY (USA). Sep 1988. 124p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-87PC79880. Order Number DE91009898. Source: OSTI; NTIS; GPO Dep.

The major program objective is to evaluate the ability of selective agglomeration to reject pyrite as a function of raw coal handling, storage and aging. The program involves the collection of freshly mined samples of four eastern bituminous coals at the mine and transporting these coals to Otisca's Syracuse New York Lab for testing. Each of the four coals (approx. 1 ton) was to be divided at the mine into three groups. Group one was stored in 55-gallon drums purged with nitrogen (0.5 tons), group two was stored in drums and covered with mine-site tap water (0.25 tons), while group three was stored in drums under a normal atmosphere (0.25 tons). The majority of this program involves the investigation of the aging of raw coals under controlled conditions, how this aging may affect selective agglomeration, and if necessary, methods for combating the changes due to aging. This is being accomplished by first establishing a baseline for all twelve raw coal samples and then repeating the testing at specific time intervals. To date the authors have completed analyses of the samples taken during cold weather, which averaged 10°C. The paper gives results of analysis of properties of the raw coals, the pentane-agglomerated coal, and the refuse from agglomeration, as well as the aged coal. An appendix gives the Electron Spectroscopy for Chemical Analysis (ESCA or XPS) and Fourier Transform Infrared Spectroscopy (FTIR) procedures and results. 11 tabs.

14019 (DOE/PC/79880–T5) **Sulfur and mineral matter reduction in coal using selective agglomeration: Fifth quarterly technical report, October 1, 1988–December 31, 1988.** Simmons, F.J.; Keller, D.V., Jr. OTISCA Industries Ltd., Syracuse, NY (USA). Jan 1989. 55p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-87PC79880. Order Number DE91009899. Source: OSTI; NTIS; GPO Dep.

The major program objective is to evaluate the ability of selective agglomeration to reject pyrite as a function of raw coal handling, storage and aging. The program involves the collection of freshly mined samples of four eastern bituminous coals at the mine and transporting these coals to Otisca's Syracuse New York Lab for testing. Each of the four coals (approx. 1 ton) was to be divided at the mine into three groups. Group one was stored in 55-gallon drums purged with nitrogen (0.5 tons), group two was stored in drums and covered with mine-site tap water (0.25 tons), while group three was stored in drums under a normal atmosphere (0.25 tons). The majority of this program involves the investigation of the aging of raw coals under controlled conditions, how this aging may affect selective agglomeration, and if necessary, methods for combating the changes due to aging. This is being accomplished by first establishing a base line for all twelve raw coal samples and then repeating the testing at specific time intervals. To date the authors have completed analyses of the samples taken during cold weather, which averaged 10°C, and hot weather, which averaged 25°C. They are currently processing the second cold weather aging cycle. The paper gives the results of the chemical properties of the raw coals and their aged product coals. The authors have also investigated various milling conditions and their effect on the agglomeration process. Results are discussed. An appendix contains a report of coal surface analyses performed by Electron Spectroscopy for Chemical Analysis and Fourier Transform Infrared Spectroscopy. 6 tabs.

14020 (DOE/PC/79880–T6) **Sulfur and mineral matter reduction in coal using selective agglomeration: Sixth quarterly technical report, January 1, 1989–March 31, 1989.** Simmons, F.J.; Keller, D.V., Jr. OTISCA Industries Ltd., Syracuse, NY (USA). 10 Apr 1989. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-87PC79880. Order Number DE91009900. Source: OSTI; NTIS; GPO Dep.

The major program objective is to evaluate the ability of selective agglomeration to reject pyrite as a function of raw coal handling, storage and aging. The program involves the collection of freshly

mined samples of four eastern bituminous coals at the mine and transporting these coals to Otisca's Syracuse, New York Lab for testing. Each of the four coals (approx. 1 ton) was divided at the mine into three groups. Group one was stored in 55-gallon drums purged with nitrogen (0.5 tons), group two was stored in drums and covered with mine-site tap water (0.25 tons), while group three was stored in drums under a normal atmosphere (0.25 tons). The authors have investigated various milling conditions and their effect on the agglomeration process. The Kentucky No. 9 and Upper Freeport nitrogen stored coals were used for this investigation. All of the conditions used in the baseline testing were observed except for adjustments or changes in the milling technique. A special top was constructed for the jar mill which allowed for purging with gases prior to milling. Results are given. The authors also investigated agglomeration with N-heptane and kerosene using ammonium lignosulfate an 2-ethylhexanol as additives. These results are discussed. 4 tabs.

14021 (DOE/PC/79880–T7) **Sulfur and mineral matter reduction in coal using selective agglomeration: Seventh quarterly technical report, April 1, 1989–June 30, 1989.** Simmons, F.J.; Keller, D.V. Jr. OTISCA Industries Ltd., Syracuse, NY (USA). Jun 1989. 69p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-87PC79880. Order Number DE91009901. Source: OSTI; NTIS; GPO Dep.

The major program objective is to evaluate the ability of selective agglomeration to reject pyrite as a function of raw coal handling, storage and aging. The program involves the collection of freshly mined samples of four eastern bituminous coals at the mine and transporting these coals to Otisca's Syracuse, New York Lab for testing. Each of the four coals (approx. 1 ton) was divided at the mine into three groups. Group one was stored in 55-gallon drums purged with nitrogen (0.5 tons), group two was stored in drums and covered with mine-site tap water (0.25 tons), while group three was stored in drums under a normal atmosphere (0.25 tons). The aging test series consists of an initial reference sample for each coal and atmosphere, six aged samples for each of the air and water atmosphere samples, and one aged sample for each of the nitrogen atmosphere samples. The total elapsed time will be approximately 480 days for the air and water atmosphere samples and 550 days for the nitrogen atmosphere samples. Some preliminary discussion of the aging test results is presented below. The milling atmosphere and agglomerant testing have been completed. The results of analysis of samples submitted to commercial testing are not yet available. The baseline rheology testing has been completed and is presented below. The second level of testing using fuel oil and methanol is in progress. The pelletizing study will commence as soon as the final aging samples have been completed. An appendix contains a report of coal surface analyses performed by Electron Spectroscopy for Chemical Analysis and Fourier Transform Infrared Spectroscopy. 21 figs., 6 tabs.

14022 (DOE/PC/88947–T9) **Development and utilization of new diagnostics for dense-phase pneumatic transport: Quarterly technical progress report, October 1, 1990–December 31, 1990.** Louge, M.Y.; Jenkins, J.T. Cornell Univ., Ithaca, NY (USA). [1990]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-88PC88947. Order Number DE91008947. Source: OSTI; NTIS; GPO Dep.

Dense-phase pneumatic transport is an attractive means of conveying solids. Unfortunately, because of the high solid concentrations, this transport method is a difficult regime in which to carry out detailed measurements. Hence most details of the flow are unknown. In this context, the main objective of this work is to develop probes for local measurements of solid velocity and holdup in dense gas-solid flows. In particular, the authors have designed capacitance probes to measure local, time-dependent particle concentrations, and a new optical fiber probe based on laser-induced-phosphorescence to measure particle velocities. The principles for the capacitance and optical diagnostics were given in the first and second quarterly reports. A final version of the optical fiber probe was designed in the previous reporting period. Because granular flows depends strongly on the nature of their interaction with a boundary, the authors have sought in the present reporting period to verify the boundary conditions recently calculated by Jenkins [J. Appl. Mech., in press (1991)] using computer simulations. 2 refs., 2 figs.

14023 (ETDE-mf–1764488) **German-Canadian cooperation study on the techno-economical use of West-Canadian coal in Ontario and East Asia using DENSECOAL technology.** Brandis, U.; Klose, R.; Kunst, W.D.; Mueller, T. Salzgitter Industriebau GmbH (Germany, F.R); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jul 1990 183p. (In German). Contract BMFT 0326584A. Order Number DE91764488. Source: OSTI; NTIS (US Sales Only).

The German-Canadian cooperation study on the techno-economical use of West-Canadian coal in Ontario and East Asia using DENSECOAL technology was to show that the utilization of an infrastructure already existing for handling oil (pipeline, tank farms, trans-shipment) was technically feasible and economic for coal in the form of coal-water-suspensions. Laboratory investigations of different coals and their behaviour with regard to densification, transport and combustion in addition to the analysis of the existing oil pipelines formed the basis of this study. The engineering for a DENSECOAL production plant, the pipeline transport and the power station equipment as well as the cost analysis of the overall system showed that DENSECOAL can be transported in batches together with oil in oil pipelines. The specific energy costs are lower for the final consumer in case of DENSECOAL than in case of conventional transport. The results of the study will be used as criteria for the decision on the realization of the project by the industry and the Canadian Government. (orig.) With 41 tabs., 43 figs.

14024 (STEV-TORV–90-13) **Storage of crumb peat.** Burvall, J.; Jonsson, J. Statens Energiverk, Stockholm (Sweden). 1990. 17p. (In Swedish). Project STEV-216-008. Order Number DE91763511. Source: OSTI; NTIS (US Sales Only).

The storage of crumb peat (crushed sod peat with a high moisture content), poses problems similar to those involved in the storage of milled peat. However, due to the high moisture content of crumb peat, the loss of frozen peat, particularly at the bottom of the stockpile, is somewhat greater than in the case of commercial milled peat. When crumb peat is stockpiled over a longer period, the ash and moisture contents of the peat gradually increase. Moisture content increased by an average of 3% in the four test stockpiles. Substance loss resulting from oxidation amounted to 7-10%. The reported increases in the ash and moisture contents are on a level equivalent to the amounts measured earlier in the storage of milled peat. While it appears difficult to avoid a quality deterioration caused by increased ash and moisture contents in the stockpiling of crumb peat, it does seem possible to keep quality deterioration within reasonable limits by minimizing the storage period and taking measures to reduce self-heating. The following recommendations are essential in order to avoid self-heating in the stockpiles, with the subsequent risk for substance loss and fire: * Careful packing, * Avoid mixing material with large discrepancies in moisture content, * Metal objects must not be present in the stockpiles, * Minimize the amount of wood particles in the peat, * Check the temperature of the stockpiles, especially during the first two months, * Avoid running in peat with heightened temperatures resulting from being heated by the sun, * Avoid mixing newly-harvested peat with peat stored earlier in the season. (authors).

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Refer also to citation(s) 13984, 13985, 13995, 13998, 14045, 14195, 14484, 14485, 14492, 14757, 14758, 14759, 14760, 14763, 14765, 14767, 14848, 15260

14025 (DOE/PC/79915–T12) **Mechanisms of coal-water mixture combustion in fluidized beds: Final report.** Brown, R.C. Iowa State Univ. of Science and Technology, Ames, IA (USA). Sep 1990. 57p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-87PC79915. Order Number DE91008417. Source: OSTI; NTIS; GPO Dep.

The goal of this research program was to ascertain the fundamental mechanisms of coal combustion and limestone utilization when firing coal water-limestone mixtures (CWLM) in fluidized

beds. Experiments were performed in an 8-inch diameter bubbling fluidized bed combustor. The combustor was equipped for firing wither CWM or dry coal. Experiments were designed to answer questions about combustion efficiency and limestone utilization for CWM compared to dry coal. We observed that coal-water-mixtures generally burn with higher combustion efficiency than crushed coal. Although water vapor released from CWM can react directly with char, this reaction is negligibly slow at FBC temperatures compared to the char-oxygen reaction. A physical, rather than chemical, mechanism appears to active. Our experiments demonstrated that differences in combustion efficiency cannot be attributed to fundamentally different carbon elutriation mechanisms. The fact that CWM burns with higher combustion efficiency than dry coal simply reflects the fact that char-sand agglomerates formed from CWM injected into a fluidized bed are generally larger than dry coal particles fed into a bed. Calcination and sulfation tests showed that CWLM and dry coal have optimum bed temperature for sorbent utilization when burning CWLM is lower than for dry sorbent. Furthermore, the optimal sorbent utilization is higher for CWLM compared to dry sorbent. We excluded the possibility that local reducing or gasification conditions are responsible for higher sulfur retention obtained with CWLM. We conclude that intimate contact of coal and limestone in agglomerates is the primary reason for improved sorbent utilization. 42 refs., 24 figs., 9 tabs.

14026 (DOE/PC/88750–T5) **TRW Utility Demonstration Unit: Quarterly progress report, August–October 1990.** TRW, Inc., Stony Point, NY (USA). Energy Systems Group. [1990]. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC22-89PC88750. Order Number DE91008938. Source: OSTI; NTIS; GPO Dep.

The TRW Advanced Entrained Coal Combustor Demonstration Project consists of retrofitting Orange and Rockland (O & R) Utility Corporation's Lovett Plant Unit No. 3 with four (4) slagging combustors which will allow the gas/oil unit to fire 2.5% sulfur coal. The slagging combustor process will provide NO_x and SO_x emissions that meet NSPS and New York State Environmental Standards. Phase 1 involves the engineering and design of the entrained combustor system, overall entrained combustor systems engineering and balance of plant design for Lovett Station and the limestone injection and recycle process work at Cleveland. Phase 2 includes all work necessary to modify the Lovett Station Unit No. 3 to return it to commercial operation firing coal and to prepare the unit for Phase 3 testing. In Phase 3, the operation of the combustor will be demonstrated. A brief description of the required tasks and the work to be performed during the life of the contract and the overall status of work activities are presented.

14027 (DOE/PC/89755–T2) **A mathematical model for tar release in rapid devolatilization of a softening bituminous coal: Final technical progress report.** Hsu, Jaanpyng; Darivakis, G.S.; Howard, J.B.; Peters, W.A.; Sarofim, A.F. Massachusetts Inst. of Tech., Cambridge, MA (USA). Dec 1990. 60p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89755. Order Number DE91008936. Source: OSTI; NTIS; GPO Dep.

The chief aim of this project was to complete the development of a mathematical model for tar release during rapid devolatilization of softening bituminous coals. The resulting model, the so-called C model, is attractive in that it treats the quite drastic changes in coal particle morphology brought about by the interplay between coal softening and extension of the molten coal by newly generated volatiles seeking escape from the particle. In particular, the C model gives formal recognition to how modifications in the coal particle topography arising from these morphology changes, impact intrasubstrate transport of tar and surface release of tar. Comparisons with experimental data on rapid devolatilization of powdered Pittsburgh No. 8 bituminous coal, show that the C model provides good correlations for effects of temperature on tar yields and total weight loss, and a satisfying treatment of effects of elevated pressure (69) atm on tar yield. It is expected that the C model will be of interest to coal scientists interested in better fundamental understanding of coal plasticity and related softening phenomena, and to practitioners concerned with understanding and modeling devolatilization kinetics and related softening phenomena such as particle swelling and agglomeration, particularly under conditions pertinent to suspension firing of pulverized coal. 6 refs., 7 figs.

14028 (ETDE/JP-mf–1759127, pp. 58-68) **Demonstration test of coal-water slurry fuel as an oil substitution for industrial boilers.** Nakanishi, T. (The Coal Mining Research Center, Tokyo (Japan)); Nakai, S.; Sawada, M. Onaka, A. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper described the plan for the demonstration test of coal-water slurry fuel as an oil substitution for industrial boilers. Raw coal is fed from a Coal Center through a belt conveyor and coal slurry is manufactured by a two-stage grinding method with a tube mill. Coal as delivered, deashed coal and prepared coal by blending three kinds of coal are to be used and two kinds of dispersant are also to be used. Storing tanks are used after fuel oils storing tanks would be modified. These testing coal slurries are transferred directly from a wharf through the piping to the receiving tanks by equipping an unloading pump. The combustion test is carried out by using burners modified from those of a multi-fuel (coal-oil) boiler of 95t/h capacity and the results are compared with that of pulverized coal. In order to handle coal slurry for the storage and transportation like fuel oil, it is necessary to demonstrate the standardization of the properties, stability as to separation by deposition and fluidity, etc. The effect of the grinding degree and the raw coal properties on the combustibility, the ash collectability and the effect of moisture on NO_x emission are to be studied. Preliminary tests are now being conducted and the demonstration test is to be completed at the end of 1991. 5 figs., 7 tabs.

14029 (ETDE/JP-mf–1759127, pp. 75-83) **Suitable coal for circulating fluidized bed boilers and operating experience of a 300t/hr boiler.** Fujiwara, N. (Idemitsu Kosan Co. Ltd., Tokyo (Japan)); Inokuchi, K.; Ishida, K.; Hasegawa, Y. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper described the suitable coal for circulating fluidized bed boilers and the operating experience. Since any particles emitted from a furnace are recovered by a cyclone or others and recycled, complete combustion can be achieved even if coal size is larger, so that any pulverizers are unnecessary. If a desulfurizer such as lime stone is used, desulfurization can be made in the furnace. Since these boilers are operated by low temperature combustion, NO_x emission is also suppressed. Usable range of fuels are very wide. A low fuel ratio coal is desirable to get higher combustion efficiency; a high fuel ratio coal is desirable to reduce NO_x and a suitable coal satisfying both requirements exists. The environmental regulation, the specification of boilers and users are different in different areas. The ignitability, combustion efficiency and emitting characteristics of NO_x and SO_x were studied fundamentally to respond to these conditions. The demonstration test was carried out by using a boiler of 300t/h and a coal which has the fuel ratio of about 2, medium volatile matter, excellent ignitability and low sulfur content to get high combustion ratio and low NO_x emission. NO_x and SO_x were 100ppm or less independent of boiler load and the boiler efficiency was satisfied. 3 refs., 9 figs., 5 tabs.

14030 (ETDE/JP-mf–1759127, pp. 152-164) **Pilot plant experiment of fluidized-bed cement burning system.** Hamano, T. (The Coal Mining Research Center, Tokyo (Japan)); Sekiwa, T.; Mukai, K.; Hashimoto, I. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

By the present report, summary was reported of pilot plant facilities for the fluidized bed cement burning system and pilot test, so far conducted. That system is a two-kiln system, consisting of spouted bed kiln, for the hot granulation of raw material, and fluidized bed kiln, to facilitate the burning to be homogeneous by a severe control of temperature. The following result was obtained

through granulation and burning test: That system could be confirmed good in feasibility as a cement burning process in the oil fired case. Also in the coal fired case, the hot self-granulation and grain diameter control could be completed by the spouted bed kiln. The granulated grain diameter strongly depends upon the laminar temperature of granulating kiln. High temperature burnt clinker, 1400 centigrade in temperature level, could be extracted from the fluidized bed burning kiln by the overflow exhaust method. With adoption of porous type dispersion plate to the dispersion plate of fluidized bed burning kiln, formation was made of a stable fluidized bed. 7 figs., 5 tabs.

14031 (ETDE/JP-mf–1759127, pp. 165-168) **Research and development of DIOS-process (the second). I.: Summary.** Nakanishi, T. (The Coal Mining Research Center, Tokyo (Japan)). Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

Progress was explained of two R and D series, conducted by the Coal Mining Research Center and Japan Iron and Steel Federation, for increasing the number of kinds of ironmaking use raw coal. In fiscal 1978 through 1986, research was made on production technology of formed coke, which is a technology to add raw coal, mainly non-caking general coal with binder, form/carbonize it and continuously produce ironmaking use formed coke. Non-caking coal is 70 to 80% in usable rate. Direct iron ore smelting reduction technology, proceeded with as development-scheduled for a period of seven years, starting in fiscal 1988, is to directly use both general coal and iron ore of powdery or granular state, without having them treated through both the conventional coke process and sintering process, and produce pig iron by charging smelting reduction furnace with them, after having preparatorily reduced iron ore by the fluidized bed and directly or devolatilizedly treated general coal. That is a further enlargement in freedom for selecting the kinds of coal to be used and other innovative technology, completely different from the conventional blast furnace method. Continuously from now on, development, never decelerated, must be proceeded with. 4 refs., 1 fig., 1 tab.

14032 (ETDE/JP-mf–1759127, pp. 169-174) **Research and development of DIOS-process (the second). II.: Development status of new direct iron ore smelting process (DIOS-process).** Fukushima, T. (The Japan Iron and Steel Federation, Tokyo (Japan)). Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

The new coal-based direct iron ore smelting ironmaking process was explained in progress status of element research. That process consists of smelting reduction furnace, to directly use powdery ore and general coal, and finally produce smelted pig iron, fluidized bed preparatory reduction furnace, to preheat and preparatorily reduce iron ore by utilization of the sensible heat and reduction power of exhaust gas from the smelting reduction furnace, and coal addition gas reform furnace, to aim at the effective utilization and energy recovery in the system of exhaust gas from the smelting reduction furnace. The iron bath type smelting reduction furnace underwent a test, for approx. 870 hours in total, on the production of smelted pig iron, weighing 2750 ton. Its result confirmed the establishment of basic operational condition and its enlargement in scale. It also established both the heightening in energy utilization efficiency and basic technology of using general coal. The fluidized bed preparatory reduction furnace established both the possibility confirmation and stable fluidizing condition of –5mm coarse powdery ore fluidized bed treatment in both the bubble fluidized bed and circulation fluidized bed. The bubble fluidized bed, tested under condition of being directly connected to the iron bath type smelting reduction furnace, established and confirmed the operational condition of direct connection up to 750 centigrade in temperature. 4 refs., 5 figs., 3 tabs.

14033 (ETDE/JP-mf–1759127, pp. 175-178) **Research and development of DIOS-process (the second). III.: Some results of total system analysis on DIOS-process.** Fukushima, T. (The Japan Iron and Steel Federation, Tokyo (Japan)). Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

For the purpose of accelerating the R and D propulsion of new coal-based direct iron ore smelting ironmaking process, macroscopical discussion and evaluation were, mainly energywise, made of the total system. Characteristics of energy demand and supply balance in the through process production steelmill in Japan being taken into consideration, the appropriate quantity of energy to be supplied from outside of the system is ranged between 1 to 2Gcal/ton in smelted pig iron. As for the relation between the composition and operational condition of the total process, from the viewpoint of low fuel ratio and appropriate energy supply from outside of the system as well as low facility cost, the process development tends toward the high secondary combustion-low preparatory reduction, in case of presuming the iron bath type smelting reduction furnace. If that combustion-reduction, added with coal, can effectively reform gas, the condition can be enlarged to the medium/low secondary combustion-medium/high reduction ratio side. 2 refs., 7 figs.

14034 (ETDE/JP-mf–1759127, pp. 179-183) **Research and development of DIOS-process (the second). IV.: Outline of pre-reduction fluidized bed for DIOS process.** Kobayashi, K. (The Japan Iron and Steel Federation, Tokyo (Japan)). Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

The fluidized bed, utilized for the preparatory reduction of new coal-based direct iron ore smelting ironmaking process, was explained in summary of background and element research facilities. The background and function to apply the fluidized bed were studied, from the viewpoint of raw material status, and development status of total system composition and fluidized bed process. Iron ore, imported to Japan, is more than 100 million tons in annual amount, of which 64% is occupied by powdery ore. In the fluidized bed, it is required to apply the preparatory reduction treatment to granular group, having a wide range granularity distribution of heavy weight grains, more than 5.0g/cm^3 in density and less than 8mm in diameter. Mainly carbon monoxide-based gas in the fluidized bed preparatory reduction furnace is required to produce preparatory reduction ore, low/medium in reduction ratio, by reduced gas, containing oxidizing gas, produced as a result of the secondary combustion in the smelting reduction furnace. Bubbling type and circulation type being assumed as a type of fluidized bed, research is being conducted, with construction of element research use test facilities for each of those types, from 1989 on. 4 refs., 9 figs.

14035 (ETDE/JP-mf–1759127, pp. 233-246) **Combustion test of C.P.C. boiler simulator step II.** Hamano, T. (The Coal Mining Research Center, Tokyo (Japan)); Nozoe, S.; Yoshida, K. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

By the present report, the coal partial combustor (CPC) was reported in R and D status of pilot plant test (boiler simulator step II test). The CPC is to tangentially blow coal and air with a high speed into the cylindrical combustor, burn them in high temperature and high load ambient reduction atmosphere, and secondarily does produced fuel gas by a boiler. Through equipping a compact boiler, optimized in design, with a prototypical CPC and conducting continuous long term operation test, the purpose of test is made to confirm the CPC in long term reliability, and grasp the boiler system in various characteristics, CPC in basic characteristics through enriched oxygen combustion test and many kinds of coal in adoptability through usable coal range amplification test. Through that test, not to speak of NO_x exhaust characteristics and slug, behavior of combustion ash, and other operational characteristics of CPC, survey and study were also widely made of continuous long

term operation and durability, adoptability to the boiler system, etc., which survey and study gave a guidance, useful toward its being put to practical use. 7 figs., 7 tabs.

14036 (ETDE/JP-mf–1759127, pp. 247-256) **Research and development of the pressurized fluidized bed combusiton combined cycle.** Ono, T. (The Coal Mining Research Center, Tokyo (Japan)); Kunitaka, T. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorataive symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS (US Sales Only).

Rough explanation was made of pressurized fluidized bed combustion (PFBC) technology. The PFBC technology is a combustion technology to burn mixture of coal and lime stone in a fluidized state under a pressurized condition, and proceed with desulfurization, simultaneously with combustion of coal, in the furnace. It is characterized by amplified usable coal range adoptability, had by the ordinary pressure fluidized bed combustion boiler, heightening in combustion efficiency by the pressurization, in addition to the good environmentality, compactness, etc. Further due to the pressurized combustion, it is to transfer pressurized combustion gas to the gas turbine and generate electric power by surplus energy, simultaneously with pressurizing coal combustion use air by the compressor. As combined with electric power generation by the steam turbine, it can constitute a combined cycle power generation system, as usually called, which can expect a high efficiency. Outside Japan, 60 to 220MW class test is being conducted in UK, USA, Germany and Sweden. As compared with the countries abroad, Japan considerably delays and however plans to conduct 70MW class demonstration test, to be started in fiscal 1990. 14 figs., 1 tab.

14037 (ETDE/JP-mf–1759127, pp. 257-263) **Research into a low-polluting, compact, high-efficiency fluidized bed boiler capable of handling different coals.** Ono, T. (The Coal Mining Research Center, Tokyo (Japan)); Nagato, S.; Miyoshi, N.; Hiroto, Y.; Kariya, S.; Fujiwara, N. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

Development was explained of small and medium type coal boiler by the internal circulation fluidized bed combustion (CFBC) method. The development purpose of CFBC boiler, taking notice of effect, brought by its characterizing circulation flow inside the fluidized bed, is to develop a small and medium type boiler, to have combustion efficiency and low pollution, equal to those of heavy oil boiler, and be feedable with many kinds of coal. The CFBC boiler, though variously characterized, has problems in compactness, low pollution, diversification in kind of coal, controllability and reliability. Through low NO_x combustion-confirming test in fiscal 1989, prior to the demonstration test, it was confirmed that the char, circulating in the fluidized bed, contributes, by a certain means, to the mechanism of low NO_x combustion. Improtance was also confirmed of role, played by the ratio of primary air for the fluidized bed use. Through the demonstration test, it is planned to solve the foregoing problem. The demonstration test by the demonstration plant is scheduled to start with a boiling rate of 10ton/h in October, 1990 and finish in 1992. 4 figs., 3 tabs.

14038 (ETDE/JP-mf–1759127, pp. 264-272) **Wakamatsu 50MW fluidized-bed combustion boiler demonstration test update.** Ono, T. (The Coal Mining Research Center, Tokyo (Japan)); Hasegawa, S. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

In the present report, summary was introduced of 50MW fluidized-bed combustion boiler demonstration plant facilities, Wakamatsu and test result, so far recorded thereby. That demonstration plant, 50MW in output power at 156ton/h in boiling rate, is to verify various technical matters, simultaneously to actually generating electric power. The boiler is structured by combination of main bed cell (MBC) and carbon burn-up cell (CBC). Because unburnt content in exhaust gas from the MBC is reburnt by the CBC, it becomes a system, capable of effectively burn coal, amplified in usable range. The MBC is 770 to 860 centigrade in operational temperature and 1.5m/s in air tower velocity, while the CBC, in order to effectively burn unburnt content in ash, operates at higher temperature and lower air tower velocity than those of MBC. Upon testing by use of seven kinds of coal, the securing of steam temperature was confirmed to be possible from the rated load to the minimum load for each of all those kinds of coal. Also by the environmental characteristics, low pollution was demonstrated. 4 figs., 9 tabs.

14039 (ETDE/NL-mf–1760541) **Demonstration project fluidized bed boilers at AKZO Hengelo, built by Stork Boilers: A project within the framework of the Netherlands Clean Coal Program. Interim report.** Novem publiaktie No. 89/E0882/22340. Verhoeff, F. (Stork Ketels, Hengelo (Netherlands)); Holtzer, G.J. Nederlandse Maatschappij voor Energie en Milieu BV (NOVEM), Sittard (Netherlands). May 1990 36p. (In Dutch). Order Number DE91760541. Source: OSTI; NTIS (US Sales Only).

Within the framework of the Dutch National Research Program on Coal, initiated in 1981, the title project was carried out. In 1983 AKZO decided to build a coal-fired heat/power system for which a new fluidized-bed technology could be demonstrated. The fluidized bed boiler is described, and the operation from 1986 until the end of 1989 is outlined. Detailed information is presented on the research and development program and the demonstration experiments carried out until March 1988. The measurements will be completed in the first half of 1990. The final report is to be published in the end of 1990. 23 figs., 6 tabs., 2 apps.

14040 (NEI-DK–507) **Coal smoke - energy utilization: Report on experiment on Esbjergvaerket.** Soenderjyllands Hoejspaendingsvaerk, Aabenraa (Denmark); Vestkraft I/S, Esbjerg (Denmark); Voelund Energy A/S, Esbjerg (Denmark). 1990 54p. (In Danish). Order Number DE91763422. Source: OSTI; NTIS (US Sales Only).

Utilization of the heat from smoke from coal-fired power plants are described with the emphasis on corrosion in low temperature pipes and pipes walls from the flue gas content of sulphur and cluorine. (CLS).

14041 (NEI-DK–510) **Determination and correlation of coal data: Sup-report. Combustion measurements of 9 coals chars under isothermal condition (T = 703K - 723K).** Energiministeriets Energiforskningsprogram. Braendsler og forbraendingsteknik. Schmidt, G.; Toerslev Jensen, P.; Hadvig, S. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varme- og Klimateknik. Nov 1990 68p. Contract EM-1323/87-16. Order Number DE91763426. Source: OSTI; NTIS (US Sales Only).

EFP-87.

The experiments forming the basis for this study deals with the relation between coal char combustion and time at selected temperatures, around 710 K. The experiments are described and the results are shown as a relation between the weight loss and the time for the analysed coal types. The reproducibility of the experiments. As a measure of char reactivity and the relative maximum combustion rate is defined in chapter 4. The kinetic parameters which are determined by the results of the experiments and coal combustion theory are presented. (CLS).

14042 (RISO-M–2907) **The Risoe pulverized coal fired tunnel furnace.** Arendt Jensen, P.; Rathmann, O. Risoe National Lab., Roskilde (Denmark). Dec 1990. 45p. (In Danish). Contract EM-1323/87-1. Order Number DE91763380. Source: OSTI; NTIS (US Sales Only).

EFP-87. Also published in the serie Energiministeriets Energiforskningsprogram. Braendsler og forbraendingsteknik.

A pulverized coal fired tunnel furnace has been designed and constructed at Risoe. The furnace allows for a maximum input power of 1.5 MW and the furnace is well suited for local measurements in the flame. The report contains a description of the design of the furnace by use of the heat transfer code FURNRAD. The complete system includes a coal fuel preparation system, a flue

gas system and a computer based measuring and monitoring system. A discussion of the commissioning of the facility is included. (author) 5 tabs., 10 ills., 15 refs.

14043 (STEV-FBT–91-3) **Phase composition of sintered masses formed in fluidized bed combustors.** Brown, Allan (Studsvik Nuclear, Nykoeping (SE)). Statens Energiverk, Stockholm (Sweden); Studsvik Nuclear, Nykoeping (Sweden). Jun 1990. 85p. Project STEV-276-238. (STUDSVIK-NS–90-73). Order Number DE91763552. Source: OSTI; NTIS (US Sales Only).

Fluidized bed combustors are used commercially to generate heat from a variety of fuels ranging from coal to biomass. In the meantime one of the drawbacks to this form of energy production is the sensitivity of the fluidization process to the formation of conglomerates in the bed since these disrupt both air and temperature flow and thereby the efficient operation of the combustor. While it is recognized that these conglomerates are largely made up of the bed material itself it is also clear that they are formed through a sintering process in which the inorganic residues from the fuel play a leading part. X-ray powder diffraction has been used to identify the crystalline phases that are formed in bed conglomerates. Samples have been extracted, either as sintered masses or slags, from a number of commercially operated plants. The results show that the phases that are formed are, for the most part, silicates or aluminosilicates which correspond to known minerals of calcium, potassium and sodium. Glass is also present in many instances appearing to act as a binder for the sintered mass. The origin of the silicate compounds and the possible mechanisms underlying their formation are discussed in terms of the thermo-chemistry of probable precursors and the kinetics of solid-solid and solid-liquid reactions in a violently agitated system. Interpretation places heavy reliance on published phase equilibrium diagrams for the ternary oxide systems of Na, K, Ca, Al and Si even if it seems unlikely that true chemical equilibrium is reached during sinter formation. (author) (15 figs., 32 refs.).

14044 (UCRL-JC–106115) **Kinetic combustion experiments in a pressurized fluidized bed.** Wallman, P.H. (Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Energy Conversion); Carlsson, R.C.J. Lawrence Livermore National Lab., CA (USA). 15 Feb 1991. 20p. Sponsored by USDOE, Washington, DC (USA); Statens Energiverk, Stockholm (Sweden). DOE Contract W-7405-ENG-48. Contract 276 398-1. (CONF-9103145–1: Spring meeting of the western states section of the combustion institute, Boulder, CO (USA), 17-19 Mar 1991). Order Number DE91009734. Source: OSTI; NTIS; GPO Dep.

Batch combustion experiments have been performed in a bench-scale pressurized fluidized bed with the objective of establishing combustion rates under typical pressurized fluidized bed conditions. Resulting combustion conversion vs. time relationships show that pressure has no significant effect on the combustion rates of a medium-volatile bituminous coal over a wide range of practically important combustion conditions: fluidized bed temperature 700-800 C, coal particle size 0.3-4.8mm, and O_2 concentration 3-7%. Pressures of 0.2, 1 and 2 MPa are studied. The explanation of the lack of a pressure effect on the overall combustion kinetics derives from mass-transfer controlled kinetics: pressure increases the driving force for O_2 mass transfer by increasing O_2 partial pressure but reduces diffusivity at the same time. Pressure-insensitive combustion kinetics are predicted to lead to relatively high char concentrations in pressurized beds. This in turn can lead to low combustion efficiency (by excessive loss of attrited char) but also to low emissions of NO_x (high char concentrations favor NO_x reduction). Measured burning particle temperatures are also relatively low, further promoting low levels of NO_x. 15 refs., 7 figs., 1 tab.

0150 Economic, Industrial, and Business Aspects

Refer also to citation(s) 14732

14045 (ANL/EAIS/TM–39) **Comparative analyses for selected clean coal technologies in the international marketplace.** Szpunar, C.B.; Gillette, J.L. Argonne National Lab., IL (USA). Jul 1990. 309p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. Order Number DE91009851. Source: OSTI; NTIS; GPO Dep.

Clean coal technologies (CCTs) are being demonstrated in research and development programs under public and private sponsorship. Many of these technologies could be marketed internationally. To explore the scope of these international opportunities and to match particular technologies with markets appearing to have high potential, a study was undertaken that focused on seven representative countries: Italy, Japan, Morocco, Turkey, Pakistan, the Peoples' Republic of China, and Poland. The results suggest that there are international markets for CCTs and that these technologies can be cost competitive with more conventional alternatives. The identified markets include construction of new plants and refurbishment of existing ones, especially when decision makers want to decrease dependence on imported oil. This report describes potential international market niches for U.S. CCTs and discusses the status and implications of ongoing CCT demonstration activities. Twelve technologies were selected as representative of technologies under development for use in new or refurbished industrial or electric utility applications. Included are the following: Two generic precombustion technologies: two-stage froth-flotation coal beneficiation and coal-water mixtures (CWMs); Four combustion technologies: slagging combustors, integrated-gasification combined-cycle (IGCC) systems, atmospheric fluidized-bed combustors (AFBCs), and pressurized fluidized-bed combustors (PFBCs); and Six postcombustion technologies: limestone-injection multistage burner (LIMB) systems, gas-reburning sorbent-injection (GRSI) systems, dual-alkali flue-gas desulfurization (FGD), spray-dryer FGD, the NOXSO process, and selective catalytic reduction (SCR) systems. Major chapters of this report have been processed separately for inclusion on the data base.

14046 (ETDE-mf–1764549) **Ruhrkohle AG. Business report 1989.** Ruhrkohle AG, Essen (Germany, F.R.). 1990 83p. (In German). Order Number DE91764549. Source: OSTI; NTIS (US Sales Only).

The Ruhrkohle AG business report is divided into the board's report (a list of the company's branches), the situation report, with copious illustrations, and the group situation report (business development in 1989, research and development, prospects). Further information on the year 1989 deals with the energy industry in general turnover, production, research and development, employees, balance structure and financial situation, as well as group activities. An outline is also given of the important subject of mining areas for the Ruhr. Comprehensive details of the end-of-year account for Ruhrkohle AG and for the group are then presented in tabular form. (HWJ).

14047 (ETDE/NL-mf–1760542) **Netherlands Clean Coal Program: Research and technological innovation.** Nederlandse Maatschappij voor Energie en Milieu BV (NOVEM), Sittard (Netherlands). 1990 15p. (In Dutch). Order Number DE91760542. Source: OSTI; NTIS (US Sales Only).

Includes explanations in English.

NOVEM (Dutch Agency for Energy and the Environment) is involved in a variety of activities aimed at improving the energy situation and the environment. One such activity is the Netherlands Clean Coal Program (NCCP) (the Dutch acronym is NOK). This hand-out was specially prepared for Coal and Power Technology '90 and gives an outline of the NCCP and important projects. Initiated in 1981 the NCCP aims to reintroduce coal as an energy carrier for power stations and in the industry. Three main items are described: the use of coal for power generation using environmentally compatible techniques; ash utilization, especially in the building industry; and, research to support the two items mentioned before. 9 figs., 8 ills.

14048 (SR/NES–90-07) **The potential for coal liquefaction: Supporting analysis for the National Energy Strategy.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 14 Jan 1991. 34p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009205. Source: OSTI; NTIS; GPO; GPO Dep.

The Nation's abundant coal reserves make coal liquefaction a prime candidate for helping to reduce its oil imports. This report presents an analysis of the potential for coal liquefaction in the

United States during the next 40 years. The analysis was developed as part of the Energy Information Administration's analysis work on various energy excursions and scenarios to be used as input to the development of the National Energy Strategy (NES). This report focuses on the comparison of two cases, a reference case and an accelerated coal liquefaction case, and details their respective coal liquefaction potential as well as their effects on world oil prices and US coal supply and demand. It should be noted that the analytical work for this report was completed prior to the sudden rise in oil prices following Iraq's invasion of Kuwait on August 2, 1990. Given the long-term nature of the report, its conclusions would be little altered by the incorporation of this recent event. Also, neither the reference case not the accelerated coal liquefaction case in this report is intended to represent an actual forecast of future events. Rather, they provide perspectives on how the Nation's energy system might evolve under certain conditions. The accelerated coal liquefaction case differs from the reference case by one key assumption about the financial risk associated with commercial coal liquefaction. All other assumptions are common to both cases. The reference case assumes that a financial risk premium of 5.8 percent is required for the first three coal liquefaction plants built, in order to accord the additional risk usually associated with a new technology. In the accelerated case, however, this risk premium is assumed to be eliminated to developers of such plants through some form of Federal assistance, effectively lowering the coast of coal liquids. 6 figs., 1 tab.

0160 Health and Safety

14049 (ETDE/JP-mf–1759127, pp. 106-118) **Changes of coal mine safety.** Naruse, I. (The Coal Mining Research Center, Tokyo (Japan)). Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper reviewed the changes of coal mine safety. In 1945s, the accident rate per million workers was 600 or more, and the serious accidents in which 10 or more dead persons generated, were 14 cases or more. In 1955s, coal production increased to 50 million tons but the accidents increased also and the serious accidents in which 10 or more dead persons generated were 22 cases and the accident rate per million workers reached 900. The 1965s was the scrap and build age and the coal production decreased rapidly to 18 million tons but the disasters continued. In 1975s, the serious accidents decreased to 6 cases and the accident rate to 93 owing to the oil crisis and the coal mine closing. In 1985s, coal production and the accident rate decreased to 10 million tons and 93 respectively. Since the natural condition changes in each coal mine, the safety techniques depend on local coal mines and the overall techniques based on the valuable tradition and history are important. The overall techniques suitable for each local coal mine such as the use of inclined shaft transportation, automatic switching of power supplying source for metnane gas generation, central monitoring station, CO sensor, coal mine mechanization, large size boring, and gas outburst prevention, are essential. 1 fig., 4 tabs.

14050 (ETDE/JP-mf–1759127, pp. 119-123) **Present state of R and D projects for coal mine safety.** Deguchi, G. (The Coal Mining Research Center, Tokyo (Japan)). Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper introduced the present researching state for coal mine safety. In order to predict gas-outburst and rock-burst, exploration technique using a special elastic wave, that is, coal seam wave propagating prevailingly in coal seam, seismograph and AE sensor are utilized. The technique monotoring the stress concentration by a ground pressure gage is used. The ground pressure relieving method through boring is generally applied to prevent the stress concentration and many kinds of boring equipment are developed. Stress relieving by using hydraulic crushing is also studied. Accumulation of fundamental data as to coal combustion to prevent spontaneous combustion and mine fire, early detection with a CO sensor, and the development of multi-point temperature measurement using fiber optics are proceeded. The computer program for emergency ventilation propagates already and the expert system for evacuation is also developed. In order to advance the present monitoring system, application test of LAN, transmitter built in each portable safety lamp and observing robot are researched. Research and development to improve mine environment, mainly for dust is also advancing. Exchange of domestic and foreign information for mine safety technique and technical interchange is positively performed. 6 figs.

02 PETROLEUM

0202 Reserves, Geology, and Exploration

Refer also to citation(s) 14101, 14105

14051 (DOE/MC/20037–2939) **Arctic ice islands: Final report.** Sackinger, W.M.; Jeffries, M.O.; Lu, M.C.; Li, F.C. Alaska Univ., Fairbanks, AK (USA). Geophysical Inst. 1988. 322p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC21-83MC20037. Order Number DE91002027. Source: OSTI; NTIS; GPO Dep.

The development of offshore oil and gas resources in the Arctic waters of Alaska requires offshore structures which successfully resist the lateral forces due to moving, drifting ice. Ice islands are floating, a tabular icebergs, up to 60 meters thick, of solid ice throughout their thickness. The ice islands are thus regarded as the strongest ice features in the Arctic; fixed offshore structures which can directly withstand the impact of ice islands are possible but in some locations may be so expensive as to make oilfield development uneconomic. The resolution of the ice island problem requires two research steps: (1) calculation of the probability of interaction between an ice island and an offshore structure in a given region; and (2) if the probability if sufficiently large, then the study of possible interactions between ice island and structure, to discover mitigative measures to deal with the moving ice island. The ice island research conducted during the 1983-1988 interval, which is summarized in this report, was concerned with the first step. Monte Carlo simulations of ice island generation and movement suggest that ice island lifetimes range from 0 to 70 years, and that 85% of the lifetimes are less then 35 years. The simulation shows a mean value of 18 ice islands present at any time in the Arctic Ocean, with a 90% probability of less than 30 ice islands. At this time, approximately 34 ice islands are known, from observations, to exist in the Arctic Ocean, not including the 10-meter thick class of ice islands. Return interval plots from the simulation show that coastal zones of the Beaufort and Chukchi Seas, already leased for oil development, have ice island recurrences of 10 to 100 years. This implies that the ice island hazard must be considered thoroughly, and appropriate safety measures adopted, when offshore oil production plans are formulated for the Alaskan Arctic offshore. 132 refs., 161 figs., 17 tabs.

14052 (IMMR–89/201, pp. 125-133) **The Orinoco Delta, a future exploratory province for heavy and extra heavy oils.** Zamora, L.G. (Lagoven, S.A., Caracas (Venezuela)); Gonzalez S., L.; Linares, L.M. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Along the Orinoco Oil Belt there are four known large Miocene fluviodeltaic depocenters, each one of which is located in front of a present day river basin outlet. These river basins are believed to have been the feeders of the said depocenters. A fifth Middle Miocene fluvio-deltaic depocenter is postulated to exist in the Southern Orinoco Delta area, at the Eastern end of the Belt, next to the well known Cerro Negro area. This depocenter, very similar to the Cerro Negro depocenter, would have been fed by a river basin occupied today of the Yuruari-Cuyuni system. This system has been draining to the Esequibo since the beginning of the Late Miocene, according to this hypothesis. The proto-Yuruari river basin, as it is here named, would have yielded a volume of

sediments of the same order of magnitude, and of the same composition as the sediments in Cerro Negro. Given the biological and petroleum history of the Southern flank of the Eastern Venezuela basin, and provided that the southern Orinoco Delta area shared this condition, any accumulations of hydrocarbons would follow the model of the Orinoco Oil Belt. On the basis of the above hypothesis, an expectancy of oil in place for the Middle Miocene in the southern Delta has been calculated by probabilistic methods as being from about four billion to about thirty six billion cubic meters.

14053 (IMMR–89/201, pp. 134-144) **Heavy-oil resource potential of southwest Missouri.** Netzler, B.W. (Missouri Department of Natural Resources, Rolla (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Southwestern Missouri's heavy oil occurs in sandstones of the Pennsylvanian age Cherokee Group, at very shallow production depths ranging from 100 to 150 feet. The Cherokee contains four potential reservoir horizons: (1) Lower Warner interval, (2) Upper Warner interval, (3) Lower Bluejacket interval, and (4) Upper Bluejacket interval. The Lower Bluejacket and the Upper Warner contain most of the potential heavy oil reserves. The gravity of this oil ranges from 25 to 8 degrees API and is very viscous to nearly solid. Previous realistic estimates of reserves in place range from 1.4 to 8.3 billion barrels of oil (Wells, 1974; Wells and Health, 1979). The economic cutoff for production of heavy oil in Missouri is around $20/barrel. Using this amount and a proven recovery rate of up to 50 percent of oil in place using existing methods, this resource is worth from 14 to 85 billion dollars. There have been 715,000 barrels of oil produced from southwest Missouri (Vernon County) from the onset of production records in late 1966 through 1988. From 1983-1985, over half of Missouri's total oil production came from heavy oil deposits in this area.

14054 (IMMR–89/201, pp. 159-173) **Heavy crude and tar sand resources in the Soviet Union.** Medaisko, G.S. (United Nations Institute for Training and Research/United Nations Development Programme Information Centre for Heavy Crude and Tar Sands, New York, NY (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

In the Soviet Union, deposits of Heavy Crude and Tar Sands are widespread. Ultimate resources of heavy oil and natural bitumen are large, possibly larger even than conventional crude resources. Heavy oil resources in the USSR have been estimated variously at 200 to 900 billion barrel-in-place, five to ten percent of which falls into the Reserves category, and natural bitumen-in-place at anywhere between 800 to 1,153 billion barrels. Accurate data on Russian heavy oil and bitumen is lacking, owing to their limited production which represents but a small percentage of the 4.6 billion barrel of crude and condensate which the Soviets will be producing in 1989. In Russia, all mobile hydrocarbons with viscosities ranging from 30 to several thousand centipoises are regarded as heavy crude whereas bitumen are non mobile or very low mobility hydrocarbons with viscosities up to several million of centipoises. In addition, heavy crude deposits have an oil/water contact whereas in the case of bitumen deposits, the host rock pores themselves often contain free water. In the following chapters, the main occurrences of heavy oil and bitumen in the U.S.S.R. will be reviewed briefly.

14055 (OCS/MMS–90-0072) **Federal offshore statistics, 1989: Leasing, exploration, production, and revenues.** Harris, W.M.; Heimberger, M.L.; O'Brien, D.; Thurston, L. (comps.). Minerals Management Service, Herndon, VA (USA). Office of Offshore Information and Publications. [1989]. 114p. Sponsored by Department of the Interior, Washington, DC (USA). Source: OSTI; Office of Offshore Information and Publications, Minerals Management Service, Mail Stop 4610, 381 Elden Street, Herndon, VA 22070-4817.

This eighth edition of Federal Offshore Statistics reports the mineral leasing, exploration, and production activities on the submerged lands and seabeds of the Nation's Outer Continental Shelf (OCS), as of December 31, 1989. This edition also includes selected offshore statistics provided by the coastal States. In accordance with standard accounting practice, parentheses used within the report's tables indicate negative numbers that are not added in a given column or numbers that are subtracted from a column. This 1989 edition includes corrections to previously reported data resulting from internal audits and recapitulations. The corrected figures are taken from current OCS Statistical Summaries and supersede figures published earlier by the Minerals Management Service (MMS). 67 tabs.

14056 (SAND–90-1074C) **Parameterizing and block-averaging electrical characteristics of a reservoir: An essential part of electrical/electromagnetic evaluation of production process.** Mansure, A.J. Sandia National Labs., Albuquerque, NM (USA). [1990]. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9010327–1: 1. annual Automated Resource for Chemical Hazard Incident Evaluations (ARCHIE) conference, Houston, TX (USA), 22-25 Oct 1990). Order Number DE91009173. Source: OSTI; NTIS; GPO Dep.

The geology of an oil reservoir is not homogeneous at the scale of resolution of an electrical/electromagnetic (E/EM) measurement or at the grid scale of an oil reservoir simulator. This paper discusses issues governing how the petrophysical laws governing resistivity of homogeneous rocks average to give bulk or grid scale resistivity. The bulk-averaged resistivity of a heterogeneous material measured by a given E/EM technique is a function of the direction of current flow relative to any structure of the material. The difference in bulk resistivity between current flowing across and parallel to geologic structure is frequently significant resulting in a material that is anisotropic. Failure to recognize the importance of the direction of current flow can lead to significant errors in interpretating E/EM measurements. The averaging of core-scale properties (porosity, saturation, etc.) to give representative block resistivity has been analyzed using field data to ensure that the statistics (average, variance, correlation, etc.) are geologically realistic. Merely plugging average saturation and porosity into Archie's law, while ignoring how the saturation and porosity are spatially distributed, can give block resistivities that are as much as 50% off. The analysis of field data was generalized from a bedded unit to an amorphous block by considering a bimodal distribution of pore sizes. For this example the resistivity calculated using average properties can be off by a factor of ten. This demonstrates that the question of how to average properties to determine bulk resistivity is a fundamental petrophysical question, not just an artifact of the field data used. 21 refs., 12 figs.

14057 Fracture investigation by resonance sweeping technique. Mellor, D.W. 6 Oct 1990. Filed date 3 Apr 1990. Canada Patent patent application 2013725. 18p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A method is provided for determining the extent of fracturing in a mineral formation such as a petroleum reservoir by measuring hydraulic impedance. According to the invention, the height and length of a fracture in contact with a borehole can be determined by the following steps. Pressure waves are generated at closely spaced discrete frequencies in the wellbore fluid. These waves propagate to the base of the wellbore-fracture system and to the tip of the fracture. An indication is obtained at the wellhead of the resultant standing wave patterns produced in the wellbore-fracture system by the pressure waves. A theoretical model is then generated of the wellbore-fracture system. The parameters of height and length of the fracture in the model are adjusted to obtain a match with the obtained indication, in order to determine the height and length of the fracture. The pressure waves may be produced by a transmitter mounted on the wellhead. A preferred transmitter is an electromechanical pressure oscillator generating frequencies between about 10 and 200 Hz. The response signal may be measured by means of a transducer mounted on the wellhead in contact with the wellbore fluid. The method of this invention is preferably used in wellbores where neither tubing nor packers are present. The frequency applied by the transmitter to the fluid is

preferably in the 10-70 Hz range, and the discrete steps are preferably in the 0.01-0.1 Hz range. A simple mathematical model for use with the method of the invention is included. Results from a field test are presented to illustrate the invention. 7 figs.

14058 **Hydraulic impedance test method.** Mellor, D.W. 6 Oct 1990. Filed date 3 Apr 1990. Canada Patent patent application 2013726. 24p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A method is provided for determining the extent of fracturing in a mineral formation such as a petroleum reservoir by measuring hydraulic impedance. According to the invention, a hydraulic pressure transient is generated in the fluid in a borehole located in the formation. This pressure transient propagates to the bottom of the wellbore-fracture system and to the tip of the fracture. An indication of the resultant reflections of the pressure transient is obtained. A theoretical model is then generated of the wellbore-fracture system, and the parameters of height and length of the fracture in the model are adjusted to obtain a match with the obtained indication to determine the height and length of the fracture. The pressure transient may be produced by rapidly opening and closing a valve on the wellhead to initiate a water hammer type of shock wave. The response of the wellbore to the pressure transients may be measured by means of a transducer positioned at the wellhead in contact with the wellbore fluid. A simple mathematical model for use with this method is included. Field tests are described to illustrate the invention. 9 figs., 1 tab.

14059 **Method and device for wells and namely directional wells sismic prospecting.** Wittrisch, C. 6 Oct 1990. Filed date 6 Apr 1990. Canada Patent patent application 2014045. 28p. (In French). Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A method and apparatus particularly adapted to seismic prospecting in substantially horizontal wells employs intermediate frequency acoustic waves, allowing reconciliation of range and power of resolution. In a well, a transmission-receiving assembly is lowered by stages. The assembly comprises at least one probe associated with a guide block, but which can be mechanically decoupled from it, and at least one source of acoustic waves associated with a guide block. The source is placed on a rigid column connecting the probe to the maneuvering device on the surface. A connection system allows electrical connection of the probe and the source to a control and recording assembly on the surface. The source comprises one or more vibrators emitting in the 200-2,000 Hz range for example, or a sparker. The invention is especially applicable to the local study of sedimentary basins. 11 figs.

0203 Drilling and Production

Refer also to citation(s) 14053, 14102, 14910, 14980

14060 (IMMR–89/201, pp. 62-67) **Effect of horizontal wells on sweep efficiencies when practicing enhanced oil recovery in heavy oil reservoirs.** Lane, J.A. (Texas A & M Univ., College Station (USA)); Strickland, T.; Crawford, P.B. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

It has been estimated that slightly more than 500 billions barrels of oil were originally in place in reservoirs which have been discovered today. Of this amount, approximately one-third (170 billion barrels) of this oil has been produced. This leaves approximately 350 billion barrels of the oil underground, and much of this oil is heavy oil. Studies were also made for direct line drive patterns in which horizontal wells were positioned at both production and injection wells. This system can lead to the highest achievable sweep efficiencies. The approximate cost for horizontal wells is given. These costs include approximate cost for preparing the oil well, for drilling, and for completion. Horizontal drilling is now finding applications in many oil producing provinces of the world. The length of the horizontal leg may vary from a few hundred feet to a few thousand feet. Under conventional producing methods, most of the heavy oil remains in the reservoir at abandonment. If water flooding is initiated, the viscosity ratios are so unfavorable that little additional oil can be expected in most cases. It was believed that horizontal wells might substantially increase the sweep efficiencies in heavy oil reservoirs. This paper reports on the greatly improved sweep efficiencies which may be possible when using properly oriented horizontal wells in heavy oil reservoirs. Studies were also made of areal sweep efficiencies which may result if a horizontal well were drilled in an unfavorable direction, that is a horizontal well that is parallel to flow between injection and producing wells.

14061 (NIPER–466) **Critical factors in the design of cost-effective alkaline flooding.** Lorenz, P.B.; Peru, D.A. National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA). Feb 1991. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC22-83FE60149. Order Number DE91002224. Source: OSTI; NTIS; GPO Dep.

A review of major alkaline flooding projects highlights the recognized fact that alkali consumption and scale formation are serious deterrents when strong alkalis are used. The review also confirms that there are several mechanisms of oil mobilization besides reducing interfacial tension. Even oils of low acid number may be amenable to alkaline flooding. Moreover, alkalis in a lower pH range - which have minimal reaction with reservoir minerals - can often mobilize oil, especially when enhanced with a low concentration of surfactant. However, the future of alkaline flooding depends critically on improved reservoir analysis, which includes factors that have often been neglected: (1) thorough mineralogical analysis; (2) evaluation of ion-exchange properties; and (3) assessment of carbon dioxide content. An evaluation of high-pH alkaline flooding field tests over the past 60 years shows that the majority of tests did not produce encouraging results. Laboratory and limited field experience with lower pH alkalis suggests that they may be more feasible in selected cases. Alkaline flooding should be rejected if there is as much as 1% gypsum in the rock or as much as 1 mol % CO_2 in the fluid. Otherwise, a flood at moderate pH (around 10) can be considered for low-kaolinite reservoirs. For low-montmorillonite reservoirs with less than 5 meq divalent exchange ions per kg of rock, a very low pH (around 8.5) may be effective when enhanced with surfactant. 55 refs., 3 tabs.

14062 (NIPER–507) **Surfactant-enhanced alkaline flooding with weak alkalis.** French, T.R.; Josephson, C.B. National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA). Feb 1991. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC22-83FE60149. Order Number DE91002227. Source: OSTI; NTIS; GPO Dep.

The objective of Project BE4B in FY90 was to develop cost-effective and efficient chemical flooding formulations using surfactant-enhanced, lower pH (weak) alkaline chemical systems. Chemical systems were studied that mitigate the deleterious effects of divalent ions. The experiments were conducted with carbonate mixtures and carbonate/phosphate mixtures of pH 10.5, where most of the phosphate ions exist as the monohydrogen phosphate species. Orthophosphate did not further reduce the deleterious effect of divalent ions on interfacial tension behavior in carbonate solutions, where the deleterious effect of the divalent ions is already very low. When added to a carbonate mixture, orthophosphate did substantially reduce the adsorption of an atomic surfactant, which was an expected result; however, there was no correlation between the amount of reduction and the divalent ion levels. For acidic oils, a variety of surfactants are available commercially that have potential for use between pH 8.3 and pH 9.5. Several of these surfactants were tested with oil from Wilmington (CA) field and found to be suitable for use in that field. Two low-acid crude oils, with acid numbers of 0.01 and 0.27 mg KOH/g of oil, were studied. It was shown that surfactant-enhanced alkaline flooding does have merit for use with these low-acid crude oils. However, each low-acid oil tested was found to behave differently, and it was concluded that the applicability of the method must be experimentally determined for any given low-acid crude oil. 19 refs., 10 figs. 4 tabs.

14063 **Gellable aqueous composition and its use in enhanced petroleum recovery.** Lockhart, T.P. 6 Oct 1990. Filed

date 30 Mar 1990. Canada Patent patent application 2013461. 24p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

The permeability of high-permeability zones in an oil reservoir can be reduced by using a gellable aqueous composition with delayed gelation, according to this invention. The composition comprises water, a high-molecular weight natural or synthetic water-soluble polymer cross-linkable by means of Cr(III) ions, a water-soluble inorganic Cr(III) salt, a gelation-retardant organic ligand definable by the formula COX-R-COOH, and relative water-soluble salts. In this formula, R is a direct single bond, or a saturated or unsaturated linear or branched aliphatic C_{1-6} hydrocarbon radical, or a C_{3-7} cycloalkyl radical, or an aryl radical; X is OH or OR^1, where R^1 is a C_{1-5} alkyl radical, or NR^2R^3, where R^2 and R^3 are equal or different and are H or a C_{1-5} alkyl radical. Examples of particularly suitable organic ligands include oxalic acid, adipic acid, malonic acid, maleic acid, fumaric acid, succinic acid, and the monoamide of glutaric acid. The water-soluble polymer is present in a concentration of between 1,000 and 50,000 ppM. Particularly suitable as polymers for the purposes of the invention are acrylamide polymers and polysaccharides. The Cr(III) salt is present in a concentration of between 10 and 5,000 ppM evaluated as metal; the polymer/Cr(III) weight ratio varies from 1:1 to 1,000:1; the molar organic ligand/Cr(III) ratio varies from 0.5:1 to 500:1; and the composition has a pH equal to or less than about 7.0. A method for reducing the permeability of high-permeability zones in an oil reservoir using the composition of this invention is also disclosed. Experiments are described to illustrate the invention. 5 tabs.

14064 Method and composition for reducing the permeability of a high-permeability zone in an oil reservoir. Lockhart, T.P. 6 Oct 1990. Filed date 30 Mar 1990. Canada Patent patent application 2013468. 14p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A method for reducing the permeability of a high-permeability zone in a high-temperature oil reservoir comprises preparing a gellable polymeric aqueous solution, operating on the surface under controlled conditions; injecting this solution into the reservoir; moving the solution through the reservoir until it reaches and substantially fills the high-permeability zone; and gelling the solution in situ. The gellable solution is an aqueous solution containing a Cr(III) ion cross-linking agent and a water-soluble organic polymer cross-linkable by the effect of this cross-linking agent. The solution is substantially free of ligands for the cross-linking agent and has a pH adjusted to a value within the 1.5-5.5 range, depending on the desired gelling time. Suitable polymers for use with this invention include biopolymers such as xanthan gum, guar gum, celluloses, and modified starches, or synthetic polymers such as acrylamide polymers. The concentration of these polymers in the solution can vary from 1,000 to 50,000 ppM; the concentration of the Cr(III) agent is preferably between 25 and 500 ppM. The polymer/Cr(III) weight ratio is preferably maintained between 25:1 and 500:1. Experiments are described to illustrate the invention. 1 fig., 1 tab.

14065 Gellable buffered aqueous composition and its use in enhanced petroleum recovery. Lockhart, T.P. 6 Oct 1990. Filed date 30 Mar 1990. Canada Patent patent application 2013469. 19p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A gellable aqueous composition particularly suitable for reducing the permeability of high-permeability zones in an oil reservoir is disclosed. The composition comprises a water-soluble organic polymer cross-linkable by the effect of a polyvalent metal ion cross-linking agent; a Cr(III) ion cross-linking agent; and a buffer agent free or substantially free of ligand characteristics toward the cross-linking agent, and chosen from organic bases and carboxylic or sulfonic aromatic organic acids. The solution pH is adjusted to a value within the range of about 2 to 7. Polymers suitable for the invention include polysaccharides and acrylamide polymers. The concentration of polymer in the solution can vary from 1,000 to 50,000 ppM; the concentration of the Cr(III) agent can vary between 10 and 5,000 ppM; and the polymer/Cr(III) weight ratio is preferably maintained between 5:1 and 500:1. Experiments are described to illustrate the invention. A method for reducing the permeability of high-permeability zones using the composition of the invention is also provided. 1 fig., 5 tabs.

14066 Gellable aqueous composition and its use in enhanced petroleum recovery. Lockhart, T.P. 6 Oct 1990. Filed date 30 Mar 1990. Canada Patent patent application 2013467. 19p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A gellable aqueous composition able to reduce the permeability of high-permeability zones in an oil reservoir is disclosed. The composition is an aqueous solution containing a water-soluble organic polymer cross-linkable by the effect of a polyvalent metal ion cross-linking agent; a Cr(III) ion cross-linking agent; and a ligand for the cross-linking agent chosen from water-soluble organic alpha-hydroxy acids and alpha-amino acids. The polymer is present in a concentration of between 1,000 and 50,000 ppM; the Cr(III) ion is present in a concentration of between 10 and 5,000 ppM; the polymer/Cr(III) weight ratio varies from 1:1 to 1,000:1; the ligand is present in a quantity of between 0.5 and 500 moles per gram atom of Cr(III); and the composition has a pH equal to or less than about 7.0. Suitable polymers for the invention include polysaccharides, modified polysaccharides, and acrylamide polymers. A method for reducing the permeability of high-permeability zones in an oil reservoir using the composition of the invention is also provided. Experiments are described to illustrate the invention. 8 tabs.

14067 Method and device for production logging in a flowing well. Lessi, J. 22 Sep 1990. Filed date 22 Mar 1990. Canada Patent patent application 2012772. 19p. (In French). Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

The production logging device of this invention is intended especially for use in inclined or horizontal wells. The device consists of sealing means, measuring means adapted to treat at least a part of the upstream and/or downstream flow relative to the sealing means, and means for controlling the difference in pressure on the two sides of the sealing means. The device may be lowered into the well on a tubing string and the measurements may be made on the surface. A method for carrying out production logging using the above device is also disclosed. 3 figs.

14068 Offshore oil production system. Forsyth, D.G.W.; Marshall, R.W.; Thompson, A.M. 15 Sep 1990. Filed date 9 Mar 1990. Canada Patent patent application 2011835. 20p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

An offshore oil production and mooring system comprises a subsea base located on the sea bed associated with the following devices. A subsea connector is adapted to connect a subsea wellhead production system to a production riser. A subsea retaining buoy is located at a position below the sea surface but above the sea bed. A buoyant riser endpiece adapted for connection to a loading vessel is located in its rest position at a position below the sea surface but above the sea bed, and is anchorable to the sea bed. A flexible lower support line pivotally connects the restraining buoy to the subsea base. A flexible upper support line pivotally connects the restraining buoy to the riser endpiece. A flexible production riser is connected to the subsea connector, is supported by the lower support line, the subsea restraining buoy, and the upper support line, and is connected to the riser endpiece. When moored to the system, a tanker vessel is free to rotate around the mooring system using the torsional flexibility of the lower support line, the riser, and an umbilical and water injection line if present. There are no swivels in the system, thus reducing complexity and costs. 9 figs.

14069 Controlled path drill tool equipped with a variable geometry stabilizer and utilization of said tool. Morin, P.; Bardin, C.; Boulet, J. 7 Aug 1990. Filed date 29 Dec 1989. Canada Patent patent application 2006939. 32p. (In French). Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du

Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

The tool of this invention is intended to be placed at the end of a drill string. The tool permits real-time control of the variations in direction and inclination during drilling, precise control of the azimuth and radius of curvature, and reduction of rubbing and pinching without the need to pull the tool back to the surface. The tool of the invention includes a drilling tool placed at its lower end, a motor for rotating the drilling tool, and a variable geometry stabilizer. The tool of the invention can also include another stabilizer and/or elbow element. The stabilizer or stabilizers may be remotely controlled from the surface. The use of the tool of the invention is illustrated in the case of drilling a directional well. 23 figs.

14070 Monitoring drilling mud composition using ion selective electrodes. Jasinski, R.; Fletcher, P. 31 Jul 1990. Filed date 8 Nov 1989. Canada Patent patent application 2002450. 19p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

In the rotary drilling of oil wells, a drilling mud is used both to transport cuttings and to impose a hydrostatic pressure on the borehole walls. For these functions the mud must, for example, have an acceptable density and viscosity. It is therefore important to monitor the characteristics of the mud, and to keep them within certain limits. Recently, drilling practice has recognized the importance of monitoring the mud's ionic composition. The technique proposed in this invention is to use an ion selective/ion selective electrode pair to measure in the mud the potential difference generated by a selected ion pair. One electrode is chosen to be selective to the ion to be determined and the other is chosen to be selective to another, known ion, and is used as the reference electrode. The latter electrode is preferably chosen to be selective for an ion of the opposite sign to the ion to be determined. By knowing the concentration of the known ion, the concentration of the other can then be determined. The method of the invention appears to be applicable to the determination of the ionic composition of any variety of water-based drilling mud. In practice, the electrodes are placed in the drilling mud as it circulates in the system; a convenient location for electrode placement is after the mud has emerged from the bore and the cuttings separated off. 1 fig., 3 tabs.

14071 Monitoring drilling mud composition using flowing liquid junction electrodes. Jasinski, R.; Fletcher, P.; Vercaemer, C. 31 Jul 1990. Filed date 8 Nov 1989. Canada Patent patent application 2002451. 21p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

In the rotary drilling of oil wells, a drilling mud is used both to transport cuttings and to impose a hydrostatic pressure on the borehole walls. For these functions the mud must, for example, have an acceptable density and viscosity. It is therefore important to monitor the characteristics of the mud, and to keep them within certain limits. Recently, drilling practice has recognized the importance of monitoring the mud's ionic composition. The technique proposed in this invention is to use an ion selective/reference electrode pair to measure in the mud the potential of the selected ion (as a potential difference), and thus allow a determination of that ion's concentration. The reference electrode is of the type having a liquid junction via an aperture within the reference electrode containment vessel. The nature of drilling mud is such that some undesirable interaction between the mud components and the reference electrode occurs, possibly leading to erroneous results. It is suggested that this problem can be handled if, during the determination, the electrolyte constituting the reference electrode's liquid junction is caused to flow through the electrode containment vessel's aperture and out of the vessel into the mud. 2 figs., 3 tabs.

14072 Drilling fluids and muds containing selected ester oils. Mueller, H.; Herold, C.-P.; Tapavicza, S. von; Grimes, D.J.; Braun, J.-M.; Smith, S.P.T. 31 Jul 1990. Filed date 19 Dec 1989. Canada Patent patent application 2006009. 28p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

This invention relates to novel drilling fluids based on ester oils and to invert drilling muds based on ester oils. These fluids combine high ecological compatibility with good stability and performance properties for well drilling, and are especially applicable for drilling offshore wells where careful attention has to be paid to protecting the local marine ecosystem. The invention provides an invert emulsion drilling mud free from mineral oil comprising a continuous oil phase, a dispersed aqueous phase, at least one emulsifier, at least one weighting agent, at least one fluid loss additive, and a mild alkaline reserve. The continuous oil phase is composed predominantly of at least one monocarboxylic acid ester of a C_{2-12} monofunctional alkanol, in which the monocarboxylic acid contains from 12 to 16 carbon atoms and is aliphatically saturated. In a preferred embodiment, the ester oils used in the continuous oil phase have solidification values below −10°C, and flash points preferably above 150-160°C. In another important embodiment, the ester oils are derived from materials of predominantly vegetable origin. The dispersed aqueous phase is preferably present in quantities of 10 to 25 wt %. Lime can be effectively used as the alkali reserve, in quantities not exceeding ca 2 lb/bbl. Amidoamine compounds are particularly suitable as emulsifiers. In practice, the weighting agent used is baryta and organiphilic lignite is used as the fluid-loss additive, in the range of 5-7 wt %. Experiments are described to illustrate the properties of drilling fluids of the invention. 6 tabs.

14073 Use of selected ester oils in drilling fluids and muds. Mueller, H.; Herold, C.-P.; Tapavicza, S. von; Grimes, D.J.; Braun, J.-M.; Smith, S.P.T. 31 Jul 1990. Filed date 19 Dec 1989. Canada Patent patent application 2006010. 25p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

This invention relates to novel drilling fluids based on ester oils and to invert drilling muds based on ester oils. These fluids combine high ecological compatibility with good stability and performance properties for well drilling, and are especially applicable for drilling offshore wells where careful attention has to be paid to protecting the local marine ecosystem. The invention provides an invert emulsion drilling mud free from mineral oil comprising a continuous oil phase, a dispersed aqueous phase, at least one emulsifier, at least one weighting agent, at least one fluid loss additive, and a mild alkaline reserve. The continuous oil phase is composed predominantly of at least one monocarboxylic acid ester of a C_{2-12} monofunctional alcohol, in which the monocarboxylic acid contains from 16 to 24 carbon atoms and is olefinically mono- or poly-unsaturated. In a preferred embodiment, the ester oils used in the continuous oil phase have solidification values below −10°C, and flash points preferably above 160°C. The ester oils may be derived from materials of vegetable and/or animal origin. The dispersed aqueous phase is preferably present in quantities of 10 to 25 wt %. Lime can be effectively used as the alkali reserve, in quantities not exceeding ca 2 lb/bbl. Amidoamine compounds are particularly suitable as emulsifiers. In practice, the weighting agent used is barite and organiphilic lignite is used as the fluid-loss additive, in the range of 5-7 wt %. Experiments are described to illustrate the properties of drilling fluids of the invention. 4 tabs.

14074 Monitoring drilling mud. Jones, T.; Hughes, T.; Fletcher, P. 24 Jul 1990. Filed date 12 Dec 1990. Canada Patent patent application 2005195. 34p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

In the rotary drilling of oil wells, a drilling mud is used both to transport cuttings to the surface and to impose a hydrostatic pressure on the borehole walls. For these functions the mud must, for example, have an acceptable viscosity and density. It is thus important to monitor the characteristics of the mud and to keep them within certain limits. Only recently, however, has drilling practice recognized the importance of monitoring the ionic composition of the mud. The various techniques proposed involve separation of the mud into liquid and solid portions, with subsequent analysis of these portions. Problems with these techniques include difficulty of separation and unsatisfactory removal of fines. This invention suggests that these problems, at least, can be overcome by the

relatively simple expedient of first acidifying the mud sample. Acidification both causes the mud particles to flocculate, and so be more easily separated off, and causes the active fines to dissolve. In a preferred embodiment, hydrobromic acid is employed, together with tetramethylammonium bromide (a displacement agent which enables the cationic exchange capacity of the mud solids to be measured). Separation is carried out by filtration, and the analysis is performed by ion chromatography. The results are fed into a computer model that then calculates the original mud components. Experiments are described to illustrate the method of the invention. 2 figs., 2 tabs.

14075 Homopolysaccharide and solution containing the same; process for preparing them and their use in enhanced recovery of oil. Cros, P.; Meunier, M.-G. 17 Jul 1990. Filed date 6 Dec 1989. Canada Patent patent application 2004759. 21p. (In French). Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A solution is provided, based on an unbranched homopolysaccharide formed from a primary homopolymer chain comprising either pyranose or furanose moieties and on which may be grafted lateral chains with the same pyranose or furanose moieties. The solution may be obtained by a process consisting of the following steps. A composition based on a first homopolysaccharide is thermally treated after having adjusted the pH of the composition to a value greater than 9. The solution is then separated from the composition so treated. The first homopolysaccharide is obtained by fermentation of a carbohydrate-containing medium by a microorganism. Useful microorganisms for this purpose may be chosen from the genera Sclerotium, Corticium, Sclerotinia, and Stromatinia. Preferably, the solution according to the invention is obtained by treatment of a composition based on a first homopolysaccharide which is scleroglucane, which may be produced by fermenting a carbohydrate medium using a microorganism of the species Sclerotium rolfsii. The thermal treatment is preferentially carried out at a temperature between 80 and 130°C. The separation of the solution is preferably performed by centrifugation. The solution of the invention is advantageously used, in a homopolysaccharide concentration of 0.1-2 g/l within an aqueous brine, as a displacement fluid for enhanced oil recovery. The fluids thus prepared exhibit excellent injectability. Experiments are described to illustrate the invention. 3 tabs.

14076 System for transferring fluids from a piping system in a ship's hull to a turning device, and vice versa. Paasche, G.W.; Hanssen, K. 10 Jul 1990. Norway Patent priority 885305;CA patent application 2003725. 11p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

This invention relates to a system for transferring fluids from a piping system which is firmly connected to a ship hull to a turning device. The turning device is rotatably connected to the hull and arranged for being anchored to the sea floor, so that the ship can rotate into the wind in a stable manner. The turning device is also connected with at least one flexible riser and with hoses connected with the piping system in the hull. The turning device has a hole arranged coaxially with the axis of rotation, through which a drill string or riser may be run by the aid of a derrick. These systems are used in offshore oil and gas production, and an object of this invention is to provide such a system which does not have the disadvantage of being limited in its degree of rotation. According to the invention, the turning device is connected with the piping system in the hull via at least one swivel means for each fluid. Each swivel means has first and second mutually rotatable swivel members, between which fluids may be transferred during mutual rotation of the swivel members. The first and second swivel members of the swivel means are substantially non-rotatably connected with the turning device and the hull, respectively. 2 figs.

14077 System for transferring fluids from a piping system in a ship's hull to a turning device, and vice versa. Paasche, G.W.; Hanssen, K. 10 Jul 1990. Norway Patent priority 885306;CA patent application 2003726. 10p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

This invention relates to a system for transferring fluids from a piping system which is firmly connected to a ship hull to a turning device. The turning device is rotatably connected to the hull and arranged for being anchored to the sea floor, so that the ship can rotate into the wind in a stable manner. The turning device is also connected with at least one flexible riser and with hoses connected with the piping system in the hull. These systems are used in offshore oil and gas production, and an object of this invention is to provide such a system which does not have the disadvantage of being limited in its degree of rotation. According to the invention, in order to permit unlimited mutual rotation of the turning device and the hull, sets of first coupling halves are provided along the periphery of the turning device, and are connected with manifolds. Each set comprises two first coupling halves for each manifold. For each manifold two hoses are provided, which are connected with the piping system in the hull, and which have a second coupling half arranged for connection with the first coupling halves. Each hose is long enough to permit the turning device to turn both ways relative to the hull over an angular distance corresponding to the angular distance between adjacent sets of first coupling halves, without the hoses being completely tensioned, when the second coupling half of the hose is connected with one of the first coupling halves. 3 figs.

0204 Processing

Refer also to citation(s) 13959

14078 Vacuum distillation device. Hamer, J.A.; Burg, C.J. Van Der; Kanbier, D.; Heijden, P. Van Der. 18 Sep 1990. UK Patent priority 89030076;CA patent application 2009564. 13p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

This invention relates to a vacuum distillation device comprising a vacuum distillation column, a furnace provided with a heat exchange tube, and a connecting conduit between the column and the heat exchange tube. Such a device is used to fractionate a hydrocarbon-containing feed sometimes referred to as long residue. An object of this invention is to provide a vacuum distillation device which allows vaporization of a major part of the feed upstream of the column inlet. To this end, the device according to the invention comprises a vacuum distillation device as described above, in which the inner diameter of the heat exchange tube increases along its length to between 2.4 and 3 times the inner diameter of the tube inlet, and in which the inner diameter of the connecting conduit gradually increases along its length to between 2.5 and 5.4 times the inner diameter of the tube outlet. During normal operation of the device of the invention, only less than 50 wt % of the feed is vaporized in the heat exchange tube in the furnace, and more feed is vaporized in the connecting conduit, so that at the outlet end of the conduit the feed comprises about 0.9 kg vapor per kg of feed. The invention provides improved heat transfer in the heat exchange tubes such that fouling is reduced, consequently more heat can be applied per unit of time in the heat exchange tube. This allows either heating of the feed to a higher temperature or increasing the throughput for the same temperature.

14079 Vacuum distillation process. Hamer, J.A.; Heijden, P. Van Der. 18 Sep 1990. UK Patent priority 89030134;CA patent application 2009565. 8p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A vacuum distillation process is provided for distilling a hydrocarbon-containing feed sometimes referred to as long residue. An object of this invention is to provide a vacuum distillation process in which excessive cracking of liquid in the collecting vessel of the distillation column is reduced. To this end, the process according to the invention comprises introducing the feed into a distillation column operating at sub-atmospheric pressure, allowing vapor to rise inside the column, allowing liquid to drop to the bottom of the column, passing liquid through a transfer conduit from the bottom to an external collecting vessel, removing and

cooling the liquid from the collecting vessel, and introducing part of the cooled liquid into the liquid passing through the transfer conduit. In this way, a good heat exchange is obtained, even if the amount of cooled liquid introduced in the liquid passing through the transfer conduit is small compared to the amount of liquid present in the collecting vessel. 1 fig.

14080 Draw-off device. Hamer, J.A.; Jeijden, P. Van Der; Hoek, P.J. 18 Sep 1990. UK Patent priority 89030084;CA patent application 2009569. 11p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

In a distillation column, a draw-off device comprises a horizontal layer of parallel, uniformly spaced gutters in fluid communication with a collecting gutter connected to a fluid outlet. In known devices used in drawing off condensed hydrocarbon vapors, the condensation of the vapor rising in the column starts at the outer surfaces of the gutter walls, and condensed liquid falls to the bottom of the column, resulting in a loss of production. In vacuum distillation in particular, this loss is considerable, since the liquid from the bottom is generally not further treated but simply used as fuel. An object of this invention is to prevent this loss of production. To this end, the device of the invention comprises a layer of gutters as described above, in which the walls of the gutters are provided with heat-insulating means. Experiments are described which show that using the draw-off device of the invention, 5% more vapors are removed as product, compared to using draw-off devices without heat-insulating means on the gutters. 2 figs.

14081 Vacuum distillation process. Hamer, J.A.; Heijden, P. Van Der. 18 Sep 1990. UK Patent priority 89030092;CA patent application 2009567. 9p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A vacuum distillation process is provided for distilling a hydrocarbon-containing feed sometimes referred to as long residue. Known processes contact the rising vapor in the distillation column with a wash liquid, which is withdrawn by means of a pump. It has been observed that in these processes, cavitation occurs in the pump, thus reducing pump life severely. A reason for the cavitation was found to be the high temperature of the wash liquid. An object of this invention is to provide a process in which the chance of cavitation in the wash-liquid pump is reduced considerably. To this end, the process of this invention comprises supplying feed to a furnace, passing heated feed comprising vapor and liquid to a distillation column operating at subatmospheric pressure, allowing vapor to rise within the column, contacting the vapor with a de-entrainment device to remove entrained liquid from the rising vapor, spraying wash liquid on the de-entrainment device, passing the mixture from the distillation column to a vessel, and withdrawing the mixture from the vessel. The mixture, which contains wash liquid, is cooled prior to being withdrawn from the vessel. This cooling can be performed by mixing the mixture with a liquid having a lower temperature. In order to save energy, the liquid used for cooling is withdrawn from the feed upstream of the furnace prior to heating. The amount of feed mixed with the wash liquid-containing mixture is such that the temperature of the mixture is just below the temperature at which the liquid will cause cavitation in the pump. 1 fig.

14082 Vacuum distillation process. Hamer, J.A.; Heijden, P. Van Der. 18 Sep 1990. UK Patent priority 89030118;CA patent application 2009571. 10p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A vacuum distillation process is provided for distilling a hydrocarbon-containing feed sometimes referred to as long residue. An object of the invention is to provide a process in which the vapor removed from the top section of the distillation column contains only a small amount of valuable hydrocarbon components. To this end, the process according to the invention comprises introducing a feed into an inlet section of a distillation column operating at subatmospheric pressure, removing liquid from a bottom section of the column, allowing vapor to pass through at least 2 condensation sections arranged above each other in the column between the inlet section and a top section, removing vapor from the top section, spraying into each condensation section a cooled liquid, and removing liquid from each condensation section. The cooled liquid which is sprayed in the uppermost condensation section further comprises liquid removed from the condensation section(s) arranged below the uppermost condensation section. 1 fig.

14083 Process to upgrade the cetane index of gas-oil mixtures obtained by direct distillation. Dubreux, B. 15 Sep 1990. Filed date 13 Mar 1990. Canada Patent patent application 2012084. 8p. (In French). Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A process is disclosed for improving the cetane number of direct distillation gas oils to make them more useful for fuelling diesel engines or for domestic heating. The process consists of contacting the oils with either hydrogen peroxide in the presence of a carboxylic acid, or with a percarboxylic acid in the presence or absence of hydrogen peroxide. In the former case, the quantity of hydrogen peroxide used per kg of gas oil is under 300 g, for reasons of economy and safety. The carboxylic acid is in practice chosen from among formic, acetic, and propionic acids, with formic acid being preferred. The carboxylic acid/hydrogen peroxide molar ratio is preferably 0.1-0.5. In the latter case, the percarboxylic acid is chosen from among performic, peracetic, and perpropionic acids. If hydrogen peroxide is not used, the percarboxylic acid is used in the same ratio as the hydrogen peroxide is used in the first case. If hydrogen peroxide is used, the percarboxylic acid/hydrogen peroxide molar ratio is preferably 0.1-0.5. Experiments are described to illustrate the process of the invention.

0205 Products and By-Products

Refer also to citation(s) 13986, 14867, 14959

14084 Fuel briquettes with combustion inhibitor and method of making same. Lask, G.-W. 31 Jul 1990. Filed date 18 Dec 1989. Canada Patent patent application 2005833. 15p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

Fuel briquets in which the fine-grain carbon carrier is wholly or mainly petroleum coke generate excessive temperatures on combustion which damage the combustion equipment. They have inadequate strength and readily disintegrate during handling and combustion. Furthermore, they frequently contain significant amounts of sulfur and therefore generate excessive amounts of SO_2 on combustion. This invention provides briquets containing petroleum coke which will burn without problems for combustion equipment, as well as an improved method of making such briquets. According to the invention, the fine-grain carbon carrier of the fuel briquets consists of petroleum coke or a mixture of petroleum coke and coal (preferably non-caking coal). Other constitutents include a binder and an excess of 2 wt % of a fine-grained combustion inhibitor comprising $CaCO_3$ or dolomite (preferably solely $CaCO_3$). During burning, a Ca-containing ash layer continually forms around the individual briquets and forms a diffusion barrier that allows oxygen to pass in such a quantity that no excessive temperatures are produced. The $CaCO_3$ also acts in desulfurizing the combustion products. Suitable binders include pitch and sulfite waste liquor. The briquets are made by mixing the carbon carrier, binder, and combustion inhibitor, and subjecting the mixture to a heat treatment sufficient to drive off volatile constituents and harden the mixture into briquet form. The heat treatment temperature is below the temperature at which the carbon carrier and combustion inhibitor react, and should not exceed 500°C. 1 fig.

14085 Process for valorizing gas from catalytic cracking and for reducing the benzene content of gasolines. Juguin, B.; Raatz, F.; Travers, C.; Martino, G. 31 Jul 1990. Filed date 22 Dec 1989. Canada Patent patent application 2006550. 20p. (In French). Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A process is disclosed for producing low-benzene gasoline with a high octane index. The process is characterized in that a catalytic reformer effluent is fractionated into a light fraction enriched in benzene and a heavy fraction depleted in benzene. The light fraction is reacted with a waste gas from a catalytic cracking process, the gas containing at least one C_{2-5} mono-olefin, through contact with a dealuminated mordenite catalyst having an overall Si/Al molar ratio above 20. The reaction is performed in such a way that an alkylated fraction is obtained. This alkylated fraction is mixed with the heavy fraction. The mixture can be used as a fuel. Experiments are described to illustrate the process of the invention. 1 fig., 5 tabs.

14085 Process for the conversion of a heavy hydrocarboneceous feedstock. Visser, D. 17 Jul 1990. Filed date 4 Dec 1989. Canada Patent patent application 2004480. 18p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A process is provided for the conversion of a heavy asphaltenes-containing hydrocarbon feedstock comprising at least 25 wt % of hydrocarbons with a boiling point of at least 520°C into products with a lower boiling point. The process comprises preheating the feedstock, passing the preheated feedstock through a thermal cracking zone so that a conversion of the hydrocarbons with a boiling point of 520°C and above of at least 35 wt % is obtained, separating the effluent from the cracking zone into one or more distillate fractions and a residual fraction, and deasphalting the residual fraction to obtain an asphalt and a deasphalted oil. The asphalt obtained contains the solid coke particles that may have formed during the cracking reactions, and the deasphalted oil contains virtually no asphaltenes, has a lower viscosity, lower density, and lower Conradson carbon number than the residual fraction obtained in the separation of the effluent from the thermal cracking zone. The deasphalted oil does not have any stability problems and can be used directly as a blending component in the preparation of a commercial fuel or other useful purposes. Convenient feedstocks for the process of this invention include atmospheric and vacuum residues of crude oils. The thermal cracking is generally carried out in the absence of reducing gases, and may be carried out in the presence of steam. The distillate fractions obtained by this process may include C_{1-4} hydrocarbon gases, gasoline, middle distillates, and vacuum distillates. Experiments are described to illustrate the yields possible when using the process of the invention. 5 tabs.

0206 Health and Safety

14087 (DOE/CE/15397–T8) **TBS Prototype Test Program in service tank bottom leak detection and repair system: Final technical report.** Lewis, D.E. Lewis Engineering and Project Management, Inc., Corpus Christi, TX (USA). Feb 1991. 256p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-89CE15397. Order Number DE91008974. Source: OSTI; NTIS; GPO Dep.

The invention is a process for detecting, locating and repairing leaks in the bottom of large storage tanks, particularly those used for storage of petroleum products. The process uses under-tank conduits as a means of testing, by vacuum and pressure measurements, to detect leaks in a tank bottom while the tank is in service. The process can also use the same conduits to inject epoxy resins under pressure to seal leaks while the tank remains in service. A prototype above ground storage tank leak test system has been built and tested. It has successfully detected leaks as small as 0.020 inch in diameter and located them by computer readout as accurately as can be measured in the tank with a measuring tape. The new method studied in this test located leaks as small as 0.020 inch in two minutes in spite of noisy conditions around the test tank area. This non-intrusive leak detection method can be constructed on tanks without taking the tank out of service. The cost of equipment installation and testing is less than one fifth the cost of installation of a second bottom. Follow up testing costs will be in the range of several thousand dollars. If second bottoms are installed the system can be used to detect leaks in the primary as well as the secondary bottom. 5 refs.

14088 Spray nozzle for fire control. Papavergos, P.G. 15 Sep 1990. Filed date 12 Mar 1990. Canada Patent patent application 2011945. 14p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A spray nozzle for fire control produces a spray of gas and liquid having an oval transverse cross-section and comprises a mixing chamber having an oval transverse cross-section adapted to induce a toroidal mixing pattern in a pressurized gas and liquid introduced to the mixing chamber through a plurality of inlets. In a preferred embodiment, the mixing chamber is toroidal. The gas is preferably air but other gases such as nitrogen, carbon dioxide, or halogenated hydrocarbons may be used. Preferably, the liquid is water or a water solution containing, for example, fire suppressants. A firefighting method using the above nozzle is also disclosed. The apparatus and method of this invention are particularly suitable for liquid hydrocarbon fires. The relatively small amount of liquid required by the spray nozzle of the invention makes it especially useful in vehicles or the like where a limited amount of liquid is available, such as trains, ships, offshore modules, oil rigs, and aircraft. It is also useful where the use of excessive amounts of liquid should be avoided, as in underground workings, hotels, warehouses, and computer rooms. 5 figs.

0207 Economic, Industrial, and Business Aspects

Refer also to citation(s) 14055, 14093, 14729

14089 (DOE/EIA–0109(91/03)) **Petroleum supply monthly, March 1991.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 29 Mar 1991. 175p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91010246. Source: OSTI; NTIS; GPO; GPO Dep.

Data presented in this report describe the supply and disposition of petroleum products in the United States and major US geographic regions. The data series describe production, imports and exports, inter-Petroleum Administration for Defense (PAD) District movements, and inventories by the primary suppliers of petroleum products in the United States (50 States and the District of Columbia). The reporting universe includes those petroleum sectors in Primary Supply. Included are: petroleum refiners, motor gasoline blenders, operators of natural gas processing plants and fractionators, inter-PAD transporters, importers, and major inventory holders of petroleum products and crude oil. When aggregated, the data reported by these sectors approximately represent the consumption of petroleum products in the United States. Data presented in the PSM are divided into two sections (1) the Summary Statistics and (2) the Detailed Statistics. 14 figs., 56 tabs.

14090 (DOE/EIA–0520(91/03)) **International petroleum statistics report.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. Mar 1991. 53p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009882. Source: OSTI; NTIS; GPO; GPO Dep.

This report presents data on international oil production, consumption, imports, exports, and stocks. The report has three sections. Section 1 contains time series on world oil production, and on oil consumption and stocks in the Organization for Economic Cooperation and Development (OECD). This section contains annual data beginning in 1973, and monthly data for the most recent two years. Section 2 presents an oil supply/consumption balance for the market economics (i.e. non-communist countries). This balance is presented in quarterly intervals for the most recent two years. Section 3 presents data on oil imports by OECD countries. This section contains annual data beginning in 1982, and quarterly data for the most recent two years. 30 tabs.

14091 (DOE/EIA–0538(90/91-26)) **Winter fuels report, week ending March 22, 1991.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 28 Mar 1991. 67p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009861. Source: OSTI; NTIS; GPO; GPO Dep.

The Winter Fuels Report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and state and local governments on the following topics:

distillate fuel oil net production, imports and stocks for all Petroleum Administration for Defense Districts (PADD) and product supplied on a US level; propane net production, imports and stocks for PADD's 1, 2, and 3; natural gas supply and disposition and underground storage for the United States and consumption for all PADD's; residential and wholesale pricing data for propane and heating oil for those states participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the United States and selected cities; and US total heating degree-days by city. 34 figs., 12 tabs.

14092 (DOE/EIA–0538(90/91-27)) **Winter fuels report, week ending March 29, 1991.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 4 Apr 1991. 65p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91010184. Source: OSTI; NTIS; GPO; GPO Dep.

This report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and State and local governments on the following topics: distillate fuel oil net production, imports and stocks for all Petroleum Administration for Defense Districts (PADD) and product supplied on a US level; propane net production, imports and stocks for PADD's 1, 2, and 3; natural gas supply and disposition and underground storage for the United States and consumption for all PADD's; residential and wholesale pricing data for propane and heating oil for those States participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the United States and selected cities; and US total heating degree-days by city. 34 figs., 12 tabs.

0208 Waste Management

14093 (EUR–12097) **Catalytic hydrotreatment of refinery waste.** Commission of the European Communities, Luxembourg (Luxembourg). 1989. 21p. Contract no. BM025/85/FR. Source: OSTI; NTIS (US Sales Only).

The object of the project is to produce liquid hydrocarbons by the catalytic hydroprocessing of solid refinery wastes (hard pitches) in order to improve the profitability of deep conversion processes and reduce the excess production of heavy fuels. The project was mostly carried out on the ASVAHL demonstration platform site, at Solaize, and hard pitches were produced primarily by deasphalting of atmospheric or vacuum distillation residues. The project includes two experimental phases and an economic evaluation study phase. In phase 1, two granular catalysts were used to transform pitch into standard low sulphur fuel oil: a continuously moving bed, with demetallation and conversion catalyst; a fixed bed, with hydrorefining catalyst. In phase 2 of the project, it was proven that a hydrotreatment process using a finely dispersed catalyst in the feedstock, can, under realistic operating conditions, transform with goods yields hard pitch into distillates that can be refined through standard methods. In phase 3 of the project, it was shown that the economics of such processes are tightly linked to the price differential between white and black oil products, which is expected to increase in the future. Furthermore, the evolution of environmental constraints will impel the use of such methods, thus avoiding the coproduction of polluting solid residues.

0209 Environmental Aspects

Refer also to citation(s) 14093, 14147

14094 (OCS/MMS–90-0095) **The Offshore Environmental Studies Program (1973-1989): A summary of Minerals Management Service research conducted on the US Outer Continental Shelf.** Hurwitz, N.; Lang, W.; Norman, H. (eds.). Minerals Management Service, Herndon, VA (USA). Dec 1990. 223p. Sponsored by Department of the Interior, Washington, DC (USA). Source: OSTI; Environmental Studies Branch (MS-4310), Minerals Management Service, 381 Elden Street, Herndon, VA 22070.

This report provides an overview of the first 15 years of the Environmental Studies Program (ESP), conducted initially by the Bureau of Land Management and now as part of the Minerals Management Service. From 1973 to 1988, the ESP spent nearly $500 million on studies directed to better understand the US Outer Continental Shelf (OCS) and coastal environment and to use this information to document or predict effects of offshore oil and gas activities. This report organizes the hundreds of completed studies and thousands of resulting documents into 15 study topic chapters. Each chapter cites selected studies and provides a general discussion of program objectives and results. Where appropriate, each topic is discussed by OCS Region (Alaska, Atlantic, Gulf of Mexico, and Pacific). The goal of this report is to provide readers with a general account of the ESP's technical accomplishments and sources of detailed information. An introductory chapter provides background on the history of the ESP, the OCS leasing process, and the planning processes and ongoing objectives of the ESP. Technical chapters explain: geology and hazards; physical oceanography and pollution transport; remote sensing; air quality; water quality; coastal impacts; ecological monitoring; fish and fisheries resources; coastal and marine birds; protected species; archaeological resources; sociology and community planning; economics; visual and recreational resources; and information synthesis, management, and dissemination. Each chapter has been processed separately for inclusion on the data base.

14095 (STF–21A90050) **Simplified toxicity testing of drilling muds I: Marine phytoplankton Skeletonema costatum grown in test tubes.** Oestgaard, K.; Bonaunet, K. Stiftelsen for Industriell og Teknisk Forskning (SINTEF), Trondheim (Norway). Jun 1990. 72p. Order Number DE91763498. Source: OSTI; NTIS (US Sales Only).

Our current standard toxicity test of drilling muds, based on growth inhibition of the marine diatom Skeletonema costatum, has been reorganized and simplified. Instead of the traditional cultivation in Ehrlenmeyer flasks, the algae have been cultivated directly in disposal test tubes with optical properties allowing direct recording of in vivo chlorophyll fluorescence in a standard fluorometer. Sampling is thus no longer necessary, and the number of replicate cultures can easily be increased within a compact space. This means less work and increased accuracy. Independent testing of eight different drilling mud samples has generally given EC_{50}-values (estmated cell concentration) close to those reported earlier for the old test system. It is therefore suggested that the standard test now valid is replaced by the simplified version documented in this report. This can be done without quantitative adjustments of the safety limits currently applied by the Norwegian pollution authorities (SFT). 12 refs., 3 figs., 7 tabs.

0220 Transport, Handling, and Storage

Refer also to citation(s) 14087

14096 (DOE/FE–0210P) **Sulphur mines underground storage facility description.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Office of Strategic Petroleum Reserve. Oct 1990. 29p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009068. Source: OSTI; NTIS; GPO Dep.

As part of the process of continued development of the Strategic Petroleum Reserve (SPR), DOE plans to streamline the SPR system by increasing storage capacity at other larger SPR sites, and decommissioning or selling the relatively small Sulfur Mines site to increase cost-effectiveness and drawdown/distribution capability of the program. Plans are being implemented for the divesture of the Sulfur Mines storage facility including the transfer of the stored crude oil. The SPR oil currently stored at Sulfur Mines, approximately 25 million barrels, would be transferred to one or more of the larger SPR sites prior to transfer of the property to the purchaser. The purpose of this document is to provide potential respondees to the accompanying solicitation (Request for Proposals, or "RFP"), additional general and detailed technical information on the Sulfur Mines Facility that will clarify or increase a proposer's understanding of the property that the Department of Energy is offering for sale. 14 figs., 6 tabs.

14097 (DTH-ISVA-PR–71, pp. 61-72) **Bed shear-stress measurements in the vicinity of a pipeline in waves.** Sumer, B.M. (Inst. Hydrodyn. and Hydraulic Eng., Tech. Univ. (DK)); Pedersen, C.; Di Yu; Fredsoee, J. Danmarks Tekniske Hoejskole, Lyngby

(Denmark). Inst. for Stroemningsmekanik og Vandbygning. 1990. In *Progress report no. 71.* 68p. Order Number DE91763368. Source: OSTI; NTIS (US Sales Only).

Bed shear stress measurements were conducted in the vicinity o a pipe placed on and also a small distance away from a plane bed exposed to an oscillatory flow. The measurements were conducted for the values of Keulegan-Carpenter number 10, 20 and 100. The results indicate that the bed shear stress picture strongly depends on the dimensionless gap ratio. (author).

14098 Fuel oil compositions. Sexton, M.D. 6 Oct 1990. Filed date 4 Apr 1989. Canada Patent patent application 2013825. 30p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

When diesel and heating oils containing cracked components are stored at ambient or elevated temperatures in air, they become discolored and precipitate sludge or sediment. It has been found that sediment and color formation can be substantially reduced by adding certain quaternary ammonium compounds. According to this invention, fuel compositions comprise a base fuel, which may contain cracked components, and a quaternary ammonium salt. The cation of this salt is advantageously derived from the reaction of a tertiary amine with an olefin oxide in the presence of excess water to yield a solution of a quaternary ammonium hydroxide. The anion is derived from an organic acid, subject to the proviso that when the acid is an alkane monocarboxylic acid, the alkane is a straight-chain alkane. The quaternary ammonium compound is present in the fuel composition at a concentration of preferably 2-200 ppM. 5 tabs.

14099 Fuel oil compositions. Sexton, M.D.; Strange, R.H. 16 Sep 1990. Filed date 14 Mar 1990. Canada Patent patent application 2012144. 23p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

When diesel and heating oils containing cracked components are stored at ambient or elevated temperatures in air, they become discolored and precipitate sludge or sediment. It has been found that sediment and discoloration in these fuels may be substantially reduced by incorporating a small amount of guanidinium or substituted guanidinium compound in the fuel. Accordingly, this invention provides a fuel oil composition comprising a mineral diesel fuel oil or heating fuel oil, and an additive which is a guanidinium salt or substituted guanidinium salt. Two preferred methods for the synthesis of the guanidine compounds are provided. The proportion by weight of the additive is preferably from 2 to 200 ppM. Experiments are described to illustrate the invention. 5 tabs.

0230 Properties and Composition

Refer also to citation(s) 13959, 13986, 14173

14100 (EUR–12742) **Evaluation of antiknock quality of gasolines by the 'energetic criterion': Final report.** Avella, F. (Stazione Sperimentale per i Combustibili, San Donato Milanese (Italy)); Girelli, A.; Famiglietti, M.; Cattaneo, F. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Stazione Sperimentale per i Combustibili, San Donato Milanese (Italy); Centro Informazioni Studi Esperienze (CISE), Segrate (Italy). 1990. 73p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract EN3C-0054-1. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 7.50.

The aim of the present work is to test the possibility to rate the antiknock performance of gasoline by a method based on the measure of the Energetic Index in a conventional test engine. This report outlines the results of the various tests that were performed on gasolines. 13 refs., 30 figs., 21 tabs.

14101 (IMMR–89/201, pp. 104-111) **Use of biomarkers, including aromatic steroids, to indicate relationships between oil sands/heavy oils/bitumens and conventional oils, Western Canada Basin.** Brooks, P.W. (Geological Survey of Canada, Calgary, Alberta (Canada)); Fowler, M.G.; Macqueen, R.W. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Results of triaromatic steroid analyses support the previous suggestion of a single family of Lower Cretaceous oil sands/heavy oils, and confirm a genetic link between these and bitumens from Paleozoic carbonate trend deposits. Biomarker distributions from both saturated and aromatic fractions indicate that Mesozoic and Paleozoic oil sands/heavy oils/bitumens are closely related to conventional Lower Cretaceous-Mississippian oils of the Western Canada Sedimentary Basin, but are very different from conventional Middle and Upper Devonian oils.

14102 (IMMR–89/201, pp. 174-201) **Characterization of heavy oil produced from the Wolf Lake in situ combustion project.** Alex, R.F. (Alberta Research Council, Edmonton (Canada)); Fuhr, B.; Reichert, C.; Sawatzky, H.; Jha, K.; Polikar, M. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Heavy oil produced over a one year period by an in situ oxygen combustion process was compared to oil extracted from a core sample prior to initiation of the fireflood. These samples were fractionated and analyzed to determine the changes occurring in the oil as a result of the recovery process. The combustion-produced oil exhibited a decrease in viscosity and density relative to the core sample. Analyses by GC-MS indicated that light straight-chain alkanes and small aromatic molecules were formed during the combustion process. Changes in carbon number distribution were consistent with thermal cracking of the oil and subsequent fractionation during movement through the formation. The properties of the oil produced up to one year after commencement of the in situ combustion process should not cause any special problems during subsequent upgrading and refining.

0250 Combustion

Refer also to citation(s) 14100

14103 Fuel additives. Nasu, Atsushi. 6 Oct 1990. Filed date 29 Mar 1990. Canada Patent patent application 2013367. 16p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

Fuel additives are provided for improving the thermal efficiency of any kind of liquid fuel such as gasoline or gas oil and for reducing the formation of pollutants on combustion. The additives of this invention comprise a powder dissolved in a solvent which is soluble in the fuel to which the additive is added. The powder is obtained by removing water from an aqueous solution of the reaction product of a hydrocarbon oil and a strong alkali in sea water. Petroleum fractions equivalent to or heavier than the fuel, or the like, are employed as the hydrocarbon oil. These are not necessarily commercially available fractions but may be halogen-containing oils or distillates obtained by fractionation of plastic wastes or used tires. Preferred materials for the alkali component are those containing CaO, such as the alkaline products obtained from sintering shell, bone, limestone or the like. The solvent is preferably a mixture of alcohol and an organic solvent such as kerosene. The concentration of the powder in the solvent is about 1%. The resulting additive is generally used in concentrations of 0.1-0.3% for gasoline, 0.3-0.5% for light gas, and ca 1% in heavy oil. Experiments are described to illustrate the invention. 3 tabs.

03 NATURAL GAS

0302 Reserves, Geology, and Exploration

Refer also to citation(s) 14051, 14055, 14438, 14439

14104 (ENET–8900514/1) **Incidence of natural-gas at Lago Maggiore: Indirect proof of mantle-methane.** Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1990. 49p. (In German). Order Number DE91765854. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

Using chemical analyses and, in addition, radon, helium-3/helium-4 analyses and the carbon isotopes C-13 and C-14, as well as hydraulic calculations, indirect proof is furnished on the basis of three gas-samples taken at different times and different sea-levels, showing that at least one of the gas outlet locations on Lago Maggiore, at the Rivapiana Rock (San Quirico), a mantle-methane component in the order of magnitude of 1.5% of the total methane must be present. Hydraulic calculations show that, from a depth of 3000 - 3500 m downwards, the fault-system of the Insubric line running through this region must be filled with mantel-methane instead of with water and must therefore represent a very large incidence of gas. figs., tabs., 4 refs.

14105 (SR/NES–90-05) **The domestic oil and gas recoverable resource base: Supporting analysis for the National Energy Strategy.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 27 Dec 1990. 63p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009203. Source: OSTI; NTIS; GPO; GPO Dep.

Future domestic supplies of oil and natural gas will depend increasingly on the volume of currently unproved recoverable resources as current reserves are depleted. This study documents analysis undertaken in support of the National Energy Strategy Study, and focuses on an evaluation of the: Recoverable resources unavailable because access to those areas is prohibited, and potential for greater recovery of resources given advancements in exploration and production technology. Estimates of domestic resource potential were developed for four scenarios: Reference case (base technology with access to restricted areas), Advanced Technology (with restricted access), and the combined Access & Advanced case (advanced technology with access to restricted areas). 4 figs., 2 tabs.

14106 (SV-UG–90-45) **Light hydrocarbon analyses on cuttings from Gravberg-1 well.** Laier, T. (Geological Survey of Denmark (DK)). Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 83p. Order Number DE91763515. Source: OSTI; NTIS (US Sales Only).

Headspace gas analyses on canned samples of cuttings every 12 m from 756 to 6956 m showed methane concentrations from 3 ppm to 786 ppm. Desorbed gas analyses performed by acid treatment of cuttings every 100 m from 219 to 6907 m showed methane concentrations from 9 to 8130 ppb by weight. Stable carbon isotope analyses on samples giving sufficient amounts of methane varied from -1.07 to -4.13 per cent relative to PDB. Two types of hydrocarbon gases were found. One type associated with the dolerite sills 900 Ma was an isotopically heavy, δ 13 C1: -1.1 to -1.5 per cent, dry gas, presumably of abiogenic origin. The other type which was found throughout the granites was characterized by isotopically lighter methane, δ 13C1: -2.1 to -4.1 per cent, and higher contents of C2+ with C2-C4 olefins and paraffins in almost equal amounts. The second type of gas was probably formed by a catalytic reaction, since most of the gases were associated with the magnetic fraction of the cuttings. Results of desorbed gas analyses were apparently unaffected by drilling conditions. Headspace gas results did however change with drilling conditions. The concentration of hydrocarbons decreased by an order of magnitude when the drilling fluid was shifted from fresh water with no additives to a bentonite mud, at 3930 m. The decrease in hydrocarbon concentration was most likely caused by an increase in the pH of the canned samples which preventes artificial gases from being formed from the metal debris in the cuttings. Most of the hydrocarbons found in the granites were probably artificial. However, the broad range in isotopic values shows that the hydrocarbons did not simply derive from metal shavings which had a narrow range of isotopic values. Desorbed gas analyses of shallow cores of granites gave similar results to those obtained for the cuttings but the origin of these hydrocarbon is still uncertain. (32 refs.).

14107 (SV-UG–90-46) **Rock mechanics of the Gravberg well no 1.** Stephansson, O. (CENTEK, Luleaa Univ. of Technology (SE)); Savilahti, T.; Bjarnason, B. Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 65p. Order Number DE91763516. Source: OSTI; NTIS (US Sales Only).

Below 1500 m the hole is preferentially elongated an average of 60-70% over long intervals. The direction of the elongation, which is close to the direction of minimum horizontal stress, averages approximately N20degE, consistent with other stress direction estimates in the area. One interesting observation in the breakout data is that below 1500 m zones which are fractured drill in-gauge or nearly in-gauge while the intact rock shows breakout. One possible explanation for this behavior is that the mechanical properties of the fracture zones differ to such an extent from the intact rock that they do not breakout under similar stress conditions. It is shown through modeling that fracture zones will tend to have less extensive breakouts than intact rock under the same stress conditions. Another possibility is that the stress state in the fracture zones is different from that of the intact rock. No experiments were carried out in the well to specifically determine the magnitude of the stresses. However, constraints can be put on the magnitude of the minimum horizontal stress by considering leak off tests, losses of large quantities of drilling fluid, and downward focused hydrofracturing at TD. The fluid losses have been attributed to fracturing of the formation and the one in the original hole resulted in a loss of about 150 m^3. The minimum stress magnitude in the Siljan Ring area as estimated by Rummel appears to be correct. The drilling fluid losses and the hydrofracturing indicate a minimum stress which is about 60-70% of the vertical stress at 6-7 km depth. (authors) (32 refs.).

14108 (SV-UG–90-47) **The geochemical characterization of gases in the deep hole of the Siljan Ring structure, Sweden.** Jeffrey, A.W.A. (Global Geochemistry Corporation, Canoga Park (CA)). Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 166p. Order Number DE91763517. Source: OSTI; NTIS (US Sales Only).

Analyses of gases from the original hole (OH) and first and second side-track holes (ST-1 and ST-2) of the Gravberg-1 well have been completed. Hydrocarbon concentrations in Gravberg-1 gases were very low, with the major component in the drilling fluid. The highest hydrocarbon shows were associated with dolerite intrusions, and consist of a dry gas containing methane enriched in ^{13}C. This type of hydrocarbon gas may be characteristic of dolerite rocks in general. The hydrocarbons appear to be abiogenic in origin, but whether the source is mantle or crustal has not been determined. In the Gravberg-1 granite rocks, gas shows had low concentrations of hydrocarbons, which were wet, enriched in unsaturated hydrocarbons, and contained methane less enriched ^{13}C than the dolerite methane. These hydrocarbons may be indigenous to the granite rocks, perhaps formed by a Fischer-Tropsch reaction. However, several reactions promoted by the drilling operations could also contribute to these hydrocarbons. Several occurrences of hydrocarbons attributable to drilling artifacts have been identified. High butane, propene, and methane concentrations in the OH appear to be derived from a drilling lubricant. High concentrations of n-pentane in ST-1 were associated with additions of another drilling lubricant. Black material discovered at 6 km during drilling of ST-1 is a mixture of magnetite, and non-mineral components which appear to be derived from drilling fluid additives. H_2 was the major non-atmospheric component in the Gravberg-1 gases. Shallower than 6 km, it was difficult to distinguish H_2 of indigenous origin from H_2 possibly produced during drilling operations. Helium in the gas shows below 6 km was predominantly radiogenic in origin, with less than 1% attributable to an upper mantle origin. The stable isotope ratios of hydrogen in these gas shows were consistent with a low temperature origin, similar to the formation temperature at 6 km. (author).

14109 (SV-UG–90-48) **Gravity field analysis in the Siljan Ring area.** Dyrelius, D. (Uppsala Univ. (SE). Dept. of Geophysics). Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 39p. Order Number DE91763518. Source: OSTI; NTIS (US Sales Only).

Borehole gravity data were acquired in the deep well at Gravberg down to 5.1 km depth and were reduced and combined with the surface gravity data to allow a simultaneous interpretation.

This was performed by least-squares inversion with respect to the density structure of a complex, three-dimensional model. The main result is a layered density model beneath Gravberg. Compared to a previous model, calculated from the borehole gravity data by simple Bouguer plate approximation, this inversion model shows a better agreement with densities obtained by gamma-gamma logging in the well. This demonstrates the importance of taking local vertical gravity gradients into account when borehole gravity data are interpreted in terms of density. The observed vertical gradient of the borehole gravity data requires, however, that another, deeper mass deficit exists, probably somewhere between 5.1 to 7.5 km depth. A reasonable density contrast of this deep body could only be obtained by introducing a reference density that increases by about 50 kg/m^3 from the surface down to 5 km depth. Such density variation may be due to a combined effect of pressure and gradual change of composition of the rock material in the area. Empirical relationships between silica content and density in rocks show that both the local density model and the increasing background density can be readily explained by the observed variation of silica percentage. The gravity analysis shows that most of the density anomalies around the borehole can be explained by lithological differences with some possible contribution from the 1-2% increased porosity in the area. The nature of the deeper, low density body is, however, unknown. (author) (22 refs.).

14110 (SV-UG–90-49) **Reservoir evaluation.** Castano, J.; Juhlin, C.; Rissler-Aakesson, G. Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 120p. Order Number DE91763519. Source: OSTI; NTIS (US Sales Only).

The principal objective of this report is to identify zones in the Gravberg-1 well that have the potential to produce gas, and to describe the methods used in the evaluation. Some promising zones were identified, and four recommended for testing; but economic considerations and hole conditions made it possible to test only the open hole section below 5453 m. The main structural features in the area are the sub-horizontal dolerites, which are the strong, continuous seismic reflectors. They are important as many of the fractured and altered zones occur at the granite-dolerite contacts and they contain the highest methane shows. The model for reservoir development is based on laboratory data and reservoir performance during testing and water injection. The reservoir behaves in agreement with an infinite acting, non-steady state model, indicative of radial flow. In the major zones in the original hole, calculated porosity ranges from 2.7-7%; porosity measured on granite and dolerite cores averages 0.9%, with 2.9% in altered rocks and mylonite. However, with the exception of two sidewall cores, none of the major fracture zones were cored. A hydrofracturing operation was performed to fracture the formation from total depth of 6957 m down to the R-4 dolerite at 7500 m, and the results suggest that the stimulation fluids entered the formation close to TD by jacking open pre-existing fractures. Fluids recovered during DST no. 5 may have been derived between 5900-6300 m; the lower section may be blocked off. High salinity, calcium-rich water was produced at stabilized rates of 5.7 m^3 per day. The water is undersaturated with gas; the gas consists mainly of about equal parts of helium and nitrogen. The helium is derived wholey from crustal sources. The small amount of methane in the water differs in isotopic composition from the methane collected during drilling, and its source is not obvious. (authors).

14111 (SV-UG–90-50) **Petrology and mineral alterations of granite rocks from the Gravberg-1 well, Siljan impact structure, central Sweden.** Ala Adin AlDahan (Uppsala Univ. (SE). Dept. of Quaternary Geology). Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 69p. Order Number DE91763520. Source: OSTI; NTIS (US Sales Only).

The 6600 m deep rock section investigated of the Gravberg-1 well is composed of mainly ca 98 vol.% granites which are capped by ca 160 m thick red porphyry and intruded by up to 62 m thick dolerites at several levels. The granitic rocks are generally medium- to coarse-grained, sometimes porphyritic and change their colour from dominantly red to grey with increasing depth. Based on textural, mineralogical and well logging data, at least, 6 major zones of granitic rocks can be distinguished. These zones alternate between two-feldspar granite and adamellite and contain variable amounts of biotite, hornblende, chlorite, and accessory minerals. These features and ages around 1.7 Ga are typical for the post-orogenic Dala granites in central Sweden. However, below the depth of ca 4800 m, the occurrence of partly aplitic to fine grained muscovite-rich adamellite within the above described granites suggest a possibility for rocks other than the Dala granite. Macro- and microscopic mainly filled and healed fractures are observed in most granitic samples examined and particularly at granite-dolerite contacts. Although the fracturing has apparently enhanced porosity development, extensive cataclasis and mylonitization has contributed to a drastic porosity deterioration. Most fracturing and alterations are seemingly impact-generated especially in the upper 2000 m of the borehole. At depths below about 3500 m, alteration of the rocks appears to be mainly due to burial metamorphism in the range of prehnite-pumpellyite facies. A sort of transition part occurs between 2000 and 3500 m. Active circulation of meteoric fluids seems to diminish beyond the depth of ca 3500 m but isolated channels (along extensively fractured parts) may have reached and are still reaching the deepest part of the borehole. (author) (31 refs.).

14112 (SV-UG–90-51) **A mathematical and statistical evaluation of the gas data in context of the geological framework.** Granath, G. (Ariadne exploration AB (SE)). Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 87p. Order Number DE91763521. Source: OSTI; NTIS (US Sales Only).

The various gas types collected during the deep drilling at Gravberg were subject to a variety of statistical and mathematical treatments in order to possibly disclose their origin. These analyses were useful in obtaining a better understanding of the relations between the gases and the physical and chemical features of the rocks. The results thus obtained could help considerably in clarifying matters not entirely devoid of conflicting opinions. (author).

14113 (SV-UG–90-52) **Wireline logging in the Gravberg-1 well.** Rissler-Aakesson, G. (MicroLine Consulting AB (SE)). Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 146p. Order Number DE91763522. Source: OSTI; NTIS (US Sales Only).

Wireline logging of the Gravberg-1 well provided important data on physical properties of the rock penetrated. The density, sonic P-wave traveltime, dual laterlog resistivity, borehole geometry (4-arm caliper), temperature, and natural gamma-ray spectroscopy logs were all run from surface down to 5666 m in the original hole. This relatively complete set of logs has proven useful for locating fracture zones, estimating porosity, determining pore fluid salinities, interpretation of heat flow and identification of lithology. Together with borehole gravity and vertical seismic profiling the logs have provided a data base for calibration and interpretation of surface gravity, seismic and electrical data. In addition, use of more sophisticated logs, such as the formation microelectric scanner, digital sonic waveform, and geochemical logging tool have provided images of the fracture zones, been used as permeability indicators and provided information on the mineralogy, respectively. The borehole geometry tool has proven extremely valuable for interpretation of problematic zones encountered while drilling and was used on 12 separate occasions. Due to budgetary constraints, only limited logging data is available below 5666 m in the original hole and in all the sidetracks. (author) (40 refs.).

14114 (SV-UG–90-53) **Drilling.** Moore, P. (Southern International Inc., Oklahoma City, OK (US)); Brittenham, T. Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 142p. Order Number DE91763523. Source: OSTI; NTIS (US Sales Only).

The engineering and planning of the planned 5000 m well construction were based on the site specific investigations carried out in the Siljan area, previous granite drilling efforts in North America and Great Britain and gas exploration activities undertaken in the deep sedimentary basins of the world. Experienced personnel and specifically designed equipment were assembled with considerable thoroughness to enhance the probability of success of the drilling venture. A significant effort was expended to interface the drilling with the needs and requirements of the evaluation and scientific teams. The actual site construction was begun in a forested area near the village Gravberg in the spring of 1986. Following a trans-Atlantic crossing, the drilling rig and associated equipment was

assembled on the site early in the summer and drilling activities officially commenced on July 1, 1986. The report is divided into 2 parts. Part 1 deals primarily with the drilling of Gravberg-1, part 2 places more emphasis on the associated events in relationship to the drilling effort. A higher significance is placed on the drilling obstacles, operational problems and associated events than the drilling statistics, although these are included also in part 2. Where there is an interpretation, the logic for that interpretation is also presented. Conclusions and recommendations are offered in the final segment to hopefully help attain the ultimate goals of the project.

14115 (SV-UG--90-54) **Exploratory studies on deep earth sources of methane: Hg as a diagnostic and prospecting tool.** Reed, G. (Argonne National Laboratory, Ill. (US)); Jovanovic, S. Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 39p. Order Number DE91763524. Source: OSTI; NTIS (US Sales Only).

Inorganic geochemistry has been used to address a number of aspects of the problem of abiotic hydrocarbons. (1) Using the depth-concentration profile of highly volatile Hg a 'production' zone permeated by fluids enriched in Hg between 4200 m and 4800 m is identified in the Gravberg 1, Siljan drillhole. (2) Weathered, i.e., fluid permeated, zones are identified using REE trends and Hg data. (3) Temperatures (ca 800-950 deg C) related to the emplacement of granite and diabase at Siljan are determined. (4) The thermal release patterns of Hg for samples from shallow depths appears to monitor the impact generated thermal pulse. (5) Basic to the abiogenic gas theory is the presence of juvenile volatiles in the earth. To supplement ^{3}He and hydrocarbon inclusion observations, trace element correlations have been found in ocean ridge and ocean island tholeiitic glasses (Hg-Sb, Cu-Zn) and South Greenland Gardar formation rocks (Sb-Se), respectively. (authors).

14116 (SV-UG--90-55) **Evaluation of electrical resistivity results from the Siljan impact region.** Pedersen, L.B.; Zhang, P.; Juhlin, C.; Rasmussen, T. Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 45p. Order Number DE91763525. Source: OSTI; NTIS (US Sales Only).

The deep electrical log from the Gravberg well was analyzed to identify the major conductive zones in the upper 6300 m. Fracture zones some of which coincide more or less with the horizontally lying dolerites known to extend over distances of tens of kilometers are probably the main carriers of horizontally flowing electrical currents, the effects of which are predominantly measured with the magnetotelluric technique. Fracture zones are typically 10 m thick, but even on this scale they show considerable vertical heterogeneity. The rock mass surrounding these fracture zones shows a general tendency of increasing resistivity with depth. This is taken to indicate that conducting pathways in the form of microfractures are gradually sealed off due to increasing lithostatic pressure. A deviation from this tendency occurs right below the upper heavily fractured part, which extends down to a depth of approx 900 m. Below this lies a highly resistive zone of thickness 100 m and resistivity exceeding 100 000 Ωm. The electrical resistivity of the fracture zones lies between 1000 to 5000 Ωm. A remarkable feature is that except for the upper few hundred meters the fracture zones occurring at depths exceeding 4000 m generally have resistivities in the range 2000 Ωm which is significantly lower than found in the depth interval 2000 to 4000 m. Whether this is an effect to increasing fracture porosity or decreasing fluid resistivity with temperature is impossible to say with the available data. The magnetotelluric data give a clear indication that the lower part of the upper crust is less resistive, and the borehole results indicate the same trend. Based upon the recovery of saline fluids below 5.4 km in the Gravberg-1 well we make the interpretation that the decrease in resistivity as inferred from MT modelling that occurs at 6 km depth is related to a dramatic increase in salinity of pore fluids at this depth. (authors) (44 refs.).

14117 (SV-UG--90-56) **Evaluation of the seismic studies in the Siljan Ring area.** Juhlin, C. (Uppsala Univ. (SE). Dept. of Geophysics). Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 55p. Order Number DE91763526. Source: OSTI; NTIS (US Sales Only).

The report deals with the causes of reflections in crystalline rock, possible ways in which to characterize them and application of borehole techniques to locate them. The report also summarizes studies done on attenuation, shear wave anisotropy, correlation of lithology with P-wave velocity, comparison of refraction profiling velocities with those encountered in the borehole, a model for the emplacement of dolerites and, finally, a discussion about the usefulness of Vp/Vs ratios when investigating fractured rock. Methods of characterizing the reflectors from surface measurements include amplitude and frequency versus offset. Borehole techniques that are important to consider when interpreting the data are vertical seismic profiling (VSP) and the sonic, density and natural gamma logs. The most important result in the report is that on the three occasions that high amplitude reflectors were penetrated by drilling dolerites were encountered along with what appears to be highly fractured granite. The VSP shows that the reflectors are real and are not artifacts of the processing or sideswipe from out of the plane of the profile. Based on borehole observations the dolerites have higher impedance contrast than the fractured granites do in comparison to the intact granite. However, it is felt that the determining factor for whether a reflection is observed or not is the lateral continuity of the discontinuity and not the impedance contrast. The dolerites along with some acidic intrusives are the only discontinuities in impedance that have any proven lateral continuity in the well. (author).

14118 (SV-UG--90-57) **Thermal measurements from the deep Gravberg-1 well.** Balling, N. (Aarhus Univ. (DK). Dept. of Earth Sciences); Eriksson, K.G.; Landstroem, O.; Lind, G.; Malmqvist, D. Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 18p. Order Number DE91763527. Source: OSTI; NTIS (US Sales Only).

Results from thermal measurements in the Gravberg-1 well are presented, including temperature and temperature gradient data and preliminary information on thermal conductivity, heat production and heat flow. From temperature logging to a depth of 5180 m the average gradient is determined at 16.1 deg C/km. 500 m interval gradients vary between 14.4 deg C/km and 18 deg C/km, with no systematic variation with depth. Variations in heat production (from ca 5 μW/m^3 in the uppermost 1100 m Siljan granite to ca 2 μW/m^3 in the rocks beneath 5400 m) are generally associated with variations in rock type. The terrestrial heat-flow density (surface level) is preliminary estimated at 60-65 m W/m^2. The radiogenic heat production from the 6700 m drilled sequence contributes to the surface heat flow by 20-25 m W/m^2. (authors).

14119 (SV-UG--90-58) **Analysis of drill core from the Siljan Ring impact structure and related processes in shear-zone terranes.** Valley, J. (Dept. of Geology and Geophysics, Univ. of Wisconsin-Madison (US)); Komor, S. Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 140p. Order Number DE91763528. Source: OSTI; NTIS (US Sales Only).

Sampling has been conducted at the Siljan Ring, Sweden on the surface from inside and outside of the ring, from drill core in pilot holes, and from drill core and cuttings in the deep Gravberg hole. Petrographic, fluid inclusion, stable isotopic, and electron microprobe analyses were made. Four journal articles and six abstracts have been published describing this work. These studies have not detected volatiles other than H_2O in fluid inclusions from quartz in the granite. Methane, H_2 and H_2S minimum detection limits are 3 vol.% by laser Raman and 20 vol.% optically. Isotopic analysis of calcite crack-cements does not confirm the prediction of Gold that $\delta^{13}C$ values would progressively decrease with depth in the Gravberg well. Instead, the results support a model where carbon is carried downward into the granite by surface water to precipitate calcite. A correlation of low $\delta^{13}C$ (< -10) near the center of the crater and higher, but variable, $\delta^{13}C$ (-19.4 to +2.2) near the annulus exists in samples from pilot holes. This may be explained if carbon in groundwater represents mixing of two reservoirs: high $\delta^{13}C$ (≈0) from Paleozoic limestones in the annulus and low $\delta^{13}C$ (-10 to -20) from organic decay. Oxygen isotopic fractionations between quartz and feldspar are reversed (ΔQt-Fs = 0 to -1.5) in shallow granite samples from the Gravberg hole further indicating a prolonged history of water-rock interaction of very low tmperatures. (authors) (69 refs.).

14120 (SV-UG--90-59) **DDP evaluation of hydrogeological data.** Rehn, I. (Viak AB, Goeteborg (SE)); Gustafson, G. Swedish

State Power Board, Vaellingby (Sweden). 27 Nov 1990. 106p. Order Number DE91763529. Source: OSTI; NTIS (US Sales Only).

Data from shallow wells and core boreholes in the area show a permeability that decreases rapidly with depth. The fracture frequency in the core boreholes, however, is fairly constant with depth and it is assumed that the decrease of the permeability is caused by fracture fillings and stress increase with depth. Hydraulic tests in the deep borehole were successful in the portion where pure water was used as drilling fluid, i.e. 1250-3920 m. The tests made here all gave a hydraulic conductivity in the range of $K = 10^{-10}$ - 10^{-9} m/s (k = 10-100 μd). In the interval 5408-6780 m the hydraulic conductivity was estimated to be about $K = 7 \cdot 10^{-12}$ m/s (k = 0.3 μd). It should, however, be noted that the conductivity is not evenly distributed along the tested intervals but concentrated to fractured zones. Furthermore, data showed that a decrease of the conductivity with depth is probably caused by increased stress levels. Data from three drillstem tests and some indirect observations indicate a fluid pressure close to hydrostatic conditions. Tests performed in the interval between 5453-6957 m show that the fluid pressure may be somewhat lower than the hydrostatic, but the data is very uncertain. (authors).

14121 (SV-UG–90-61) **Geochemistry of the Gravberg-1 well.** Castano, J. Swedish State Power Board, Vaellingby (Sweden). 27 Nov 1990. 98p. Order Number DE91763530. Source: OSTI; NTIS (US Sales Only).

This report documents and synthesizes all of the fluid geochemical studies made in connection with the Siljan project. There appear to be three groups represented in the headspace gases: One group, clearly correlated with the dolerites, consisting largely of methane and ethane is the 'abiogenic group'. The second, 'saturate group', is dominated by saturated hydrocarbons, and it appears to correlate with many fractured intervals. The third, 'unsaturated group', is dominated by unsaturated hydrocarbons, chiefly propene. Because of the very low gas saturation in the formation water, it is unlikely that there is any free gas in the formation. The dolerites displayed the principal gas shows during drilling, but generally below 1000 ppm. The gases in the granites fall into two types: one rich in saturates, the other is dominated by unsaturated hydrocarbons. The isotopic profiles obtained from the gases in the dolerite and the granite in the original hole display typical abiogenic profiles, while a third type of gas displaying a thermogenic profile was found during drilling at ST-3, DST 5, and pump testing. The 'unsaturated group' could be the result of drilling artifacts, which we cannot rule out. The saturated hydrocarbon group is more closely allied with fracture zones; it could be an indigenous abiogenic population, or it could be derived dominantly from sedimentary organic matter driven deep into the granite along fracture zones as the result of the impact. Hydrogen and helium were found in much greater abundance than expected, particularly below 6 km. The available data do not provide credible evidence that indigenous, new oil was produced from the formation. Instead, the oil most likely is derived from diesel plus the additives used to make up the oil-based mud. (author) (44 refs.).

0303 Drilling, Production, and Processing

Refer also to citation(s) 14069, 14072, 14073, 14076, 14077, 14910

14122 Removing hydrogen sulphide from a gas mixture. Christy, J.G. 31 Jul 1990. Filed date 20 Dec 1989. Canada Patent patent application 2006093. 13p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

This invention relates, in particular, to removing hydrogen sulfide from a gas mixture in which the molar ratio of carbon dioxide to hydrogen sulfide is very large, for example between 20 and 45. Examples of such mixtures include natural gas or gas produced by coal gasification. According to the invention, the gas mixture is contacted in a main absorber at an elevated temperature with lean and regenerable aqueous absorbent to obtain a purified gas mixture and a loaded absorbent. The loaded absorbent is introduced into a separation vessel at a reduced pressure, and flash-off gas and partially regenerated absorbent are removed from the vessel. Hydrogen sulfide is removed from the flash-off gas to obtain a lean gas, and the removed hydrogen sulfide is converted into elemental sulfur. The partially regenerated absorbent is introduced into a regenerator to obtain lean absorbent for use in the first step, and a regenerator off-gas including hydrogen sulfide. The regenerator off-gas is supplied to a sulfur recovery plant to obtain elemental sulfur and a SO_2-containing off-gas. This off-gas is treated in a converter to obtain a reduced off-gas. At least part of the lean gas obtained in a previous step is mixed with the reduced plant off-gas, and the remainder is mixed with the plant off-gas. Hydrogen sulfide is removed from the mixture of reduced off-gas and lean gas to obtain substantially hydrogen sulfide-free off-gas; the removed hydrogen sulfide is converted into elemental sulfur. The absorbent used in this process includes a chemical absorbent, such as an amine, and a physical absorbent, such as sulfolane. 1 fig.

0304 Products and By-Products

14123 Process and installation for the recovery of a gaseous mix heavier hydrocarbon. Chretien, D. 15 Sep 1990. Filed date 7 Mar 1990. Canada Patent patent application 2011311. 12p. (In French). Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A process is provided for recovering heavier hydrocarbons from a gaseous mixture containing in addition lighter constituents such as hydrogen, notably for recovering C_{3+} liquefied petroleum gases from a residual gas of a petroleum refinery. According to the invention, a part of the hydrogen is eliminated from the mixture. The rest of the mixture is introduced to an intermediate level of a distillation column comprising a head condenser which assures a reflux within the column. This condenser is chilled by a refrigeration apparatus capable of supplying a cold temperature T on the order of –40°C or above this value. The hydrogen content of the remaining mixture is determined so that the dew point, at the column pressure, of the fraction of this remaining mixture constituted by the lighter components is above the temperature T but near it. In one aspect of the invention, the partial elimination of hydrogen is performed by permeation. In another variant where it is desired to produce pure hydrogen at the same time, this elimination is carried out by pressure swing adsorption. An installation for carrying out the process of the invention is also disclosed. 2 figs.

0306 Economic, Industrial, and Business Aspects

Refer also to citation(s) 14055, 14091, 14092, 14729

14124 (NEI-DK–499, pp. 1-6) **Experiences, expectations and potentials in relation to industrial cogeneration.** Olsen, K. (Dansk Naturgas A/S (DK)). Dansk Automationsselskab, Lyngby (Denmark). 1990. 157p. (In Danish). (CONF-9002180–: Conference on decentral cogeneration plants and industrial heat and power production, Lyngby (Denmark), 28 Feb 1990). In *Decentral cogeneration plants and industrial heat and power production.* Order Number DE91763388. Source: OSTI; NTIS (US Sales Only).

In 1979 the Danish government passed a resolution to utilize natural gas in domestic and district heating systems and in industry. Currently, it is accepted that cogeneration of power and heating should be based on the use of natural gas. This makes it necessary for the natural gas companies to find new sources of supply and to develope a coordinated princing structure which covers all types of natural gas fired cogeneration plants. These aspects, in connected to the future development of Danish natural gas companies, are discussed. (AB).

14125 (NEI-DK–499, pp. 1-11) **Gas motors.** Winther, O. (IFV-energi i/s (DK)). Dansk Automationsselskab, Lyngby (Denmark). 1990. 157p. (In Danish). (CONF-9002180–: Conference on decentral cogeneration plants and industrial heat and power production, Lyngby (Denmark), 28 Feb 1990). In *Decentral cogeneration plants and industrial heat and power production.* Order Number DE91763388. Source: OSTI; NTIS (US Sales Only).

The feasibility of using gas motors as the motive power source for heat and electricity production in connection with industrial processes is discussed. It is concluded that the idea is attractive, but

that the size of the plant, the future relation between prices for electricity/heat and the cost of fuel, temperature conditions and the extent of waste heat utilization must be taken into consideration. (AB).

14126 (NEI-DK–505) **Individual natural gas-fired heating systems in the year 2000.** Energiministeriets Energiforskningsprogram. Braendsler og forbraendingsteknik. Dansk Gasteknisk Center A/S, Hoersholm (Denmark); Dansk Teknologisk Inst., Taastrup (Denmark). Nov 1990 183p. (In Danish). Contract EM-1323/88-20. Order Number DE91763412. Source: OSTI; NTIS (US Sales Only).
EFP-88.

A Danish development programme on domestic gas heating systems was initiated in 1988 by the Danish Gas Technology Centre a/s in co-operation with the Danish Technological Institute and Danish boiler manufacturers. The aim of the programme is to develop a domestic gas fired heating system for the year 2000. The system should satisfy future demands with respect to energy efficiency, heating comfort, safety in operation, minimum pollution and desing. The expected development in single-family houses in Denmark up until the year 2000 is discussed. It is concluded that even though average heat losses will diminish in the future (e.g. due to a generally higher insulation standard) requirements to boiler energy output will not be reduced. Possibilities for developing entirely new heating system concepts and improving existing ones are examined. It is concluded that the traditional boiler concept is preferable and still has potential for improvements. Out of the various alternative systems evaluated, the gas radiator system is preferred. Further development of existing boiler/burner systems is considered. Design requirements for coming systems have been established, and prototype boilers and burners have been developed in co-operation with Danish boiler manufacturers. (AB).

14127 (NEI-DK–505, pp. 1-46) **Evaluation of alternative system potentials: Partial report.** Dansk Gasteknisk Center A/S, Hoersholm (Denmark). Nov 1990. 183p. (In Danish). Contract EM-1323/88-20. In *Individual natural gas-fired heating systems in the year 2000.* Order Number DE91763412. Source: OSTI; NTIS (US Sales Only).
EFP-88.

The aim was to create an overview of possibilities for individual heating systems in residential buildings. Suggestions for boiler, gas radiator, indirect and direct hot air heating, gasfired heat pump, and micro cogeneration systems are described, analysed and evaluated, and the resulting recommendations are presented. (AB).

14128 (NEI-DK–505, pp. 1-31) **Individual heating with natural gas in the year 2000: Report from boiler-and-burners group.** Paulsen, O.; Gundtoft, S.; Krighaar, M.; Hedegaard Madsen, O. Dansk Gasteknisk Center A/S, Hoersholm (Denmark); Dansk Teknologisk Inst., Taastrup (Denmark). Nov 1990. 183p. (In Danish). Contract EM-1323/88-20. In *Individual natural gas-fired heating systems in the year 2000.* Order Number DE91763412. Source: OSTI; NTIS (US Sales Only).
EFP-88.

An evaluation, by Danish experts on the subject, of boilers and burners using natural gas and the potentials for future use. (AB) 24 refs.

14129 (SR/NES–90-06) **The outlook for natural gas imports: Supporting analysis for the National Energy Strategy.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 25 Jan 1991. 49p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009204. Source: OSTI; NTIS; GPO; GPO Dep.

Net imports of natural gas increased by about 4.5 percent in 1989 to almost 1.3 trillion cubic feet, the highest level ever recorded. Most of this gas came from Canada, but liquefied natural gas (LNG) imports reached a level unseen since 1983. The increase in pipeline imports from Canada continued a trend begun in 1987 and 1988. Import volumes as a share of consumption have increased somewhat erratically, but over the last 3 years, they are at the highest relative level in history with the exception of 1979. This study documents analysis undertaken in support of the National Energy Strategy Study, and focuses on an evaluation of the: Potential flow of pipeline imports into the United States, given a favorable environment, and potential flow of LNG imports into the United States, recognizing the various factors that influence the level of LNG imports into this country. Analysis of natural gas import potential was developed for two National Energy Strategy scenarios: the Reference case and the Expanded LNG Import Capacity case. Pipeline imports are invariant between the two cases, because the chief determining factor over the extended projection period is the expected volume and attributes of the recoverable resource base for either Canada or Mexico. The flow of LNG imports into the United States varies between the two cases in the period after 2010. Projected LNG imports increase through 2010 with reactivation of existing import facilities and capacity expansion at those sites. Higher rates of flow thereafter are achieved only with additional LNG facilities constructed on sites other than those with currently existing facilities. The rate of new construction differs, reflecting the variation in optimism regarding the likelihood of these facilities being built and differences in the level of gas prices in each case. 5 figs., 15 tabs.

0308 Environmental Aspects

Refer also to citation(s) 14094

0320 Transport, Handling, and Storage

Refer also to citation(s) 14091

14130 (CONF-900801–43) **Charge/discharge characteristics of high-capacity methane adsorption storage systems.** Blazek, C.F. (Institute of Gas Technology, Chicago, IL (USA)); Jasionowski, W.J.; Tiller, A.J.; Gauthier, S.W. Institute of Gas Technology, Chicago, IL (USA). [1990]. 10p. Sponsored by Institute of Gas Technology, Chicago, IL (USA). From 25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990. Source: OSTI; Institute of Gas Technology, 3424 S. State Street, Chicago, IL 60616.

The physical and economic barriers restricting a broad acceptance of natural gas as an alternative fuel in the transportation market have proven to be formidable. In order to succeed in the marketplace, systems for storing, dispensing, and utilizing natural gas which are low-cost, lightweight, compact, and efficient must be developed and evaluated. Experiments and numerical modeling indicate that methane storage and delivery are enhanced by low flow rates, high pressures, and designs with low adsorbent-to-cylinder mass ratios. When the adsorbent-to-cylinder mass ratio is greater than 0.3, systems behavior changes from near isothermal to adiabatic. Incorporation and utilization of in-situ thermal energy storage (TES) aids heat management, maintains near isothermal conditions and improves overall performance. TES thermally buffers the charging and discharging of an adsorbent system at or near the phase change temperature of the TES media thereby, enhancing storage and delivery of methane. 1 ref., 7 figs., 3 tabs.

14131 (SVF–374) **Vacuum insulation for LNG.** Swebilius, S. (Studsvik Energy, Nykoeping (SE)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden); Studsvik Energy, Nykoeping (Sweden). Aug 1990. 40p. (In Swedish). (STUDSVIK-ED–89-35). Order Number DE91763531. Source: OSTI; NTIS (US Sales Only).

The conditions to use VSI insulation elements in LNG applications has been studied (VSI stands for Vacuum Super Insulation). The VSI insulation element is superior to conventional polyerethane foam insulation in performance. The first task was to study the pipe application for the VSI element. A test loop for district heating distribution is under construction. The VSI-pipe heat loss is 20-25% of the one for conventional PU foam pipes. At the present is not possible to get the exact cost for the VSI element from manufacturers. A calculation based on marginal cost for the LNG being gasified unvoluntarily in an insulated rock storage has given the result that VSI pipes could be much more expensive than a PU pipe and still be estimated to compete in LNG-applications. Development work to be carried out is for the producer to apply the pipe for serial production and to test and evaluate an application to LNG, specially concerning joints and the choice of sealing box design and materials.

14132 Method for enhanced pipes. Taylor, J.; Hicks, M.; Lamb, R.; Bennet, R.; Nixon, K.; Ashcroft, I.; Parkes, A.S.; Smith, J.P. 31 Jul 1990. Filed date 22 Dec 1989. Canada Patent patent application 2006504. 43p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

Service pipes are often used to connect a main supply of gas to a property. Since such pipes are often underground, if existing service pipes leak or otherwise need repair, they are costly, time-consuming, inconvenient, and environmentally deleterious to locate, excavate, and repair. A method is therefore provided to avoid these problems by enabling replacement or repair of service pipes without having to remove them. According to one aspect of the invention, a method for replacing an existing service pipe comprises disconnecting the outlet from the existing pipe, feeding a desired length of replacement pipe into the existing pipe, and connecting the outlet to the outlet end of the replacement pipe. All these steps are performed in such a way that during the connection, fluid is prevented from escaping into the property. After connection, fluid is allowed to pass to the outlet solely by way of the replacement pipe. According to another aspect of the invention, a device is provided for obturating a pipe so as to cut off fluid flow along the pipe. The device comprises a flexible tube having an inflatable obturating part. According to a third aspect, a seal is provided for use in replacing an existing fluid-carrying pipe with a replacement pipe. The seal comprises a tubular body of a flexible material, having a rear portion for connection to the leading end of the replacement pipe and a front portion adapted in use to provide a barrier to the flow of fluid along the annular gap between the internal wall of the existing pipe and the external wall of the replacement pipe. The seal also has a membrane serving to prevent the flow of fluid through the bore of the seal. 34 figs.

14133 Artificial underground cavern for storing natural gas in gas form and a process for the preparation of the cavern. Mandrin, C. 17 Jul 1990. Filed date 28 Nov 1989. Canada Patent patent application 2004000. 24p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

An artificial underground cavern for high-pressure, low-temperature storage of natural gas has a casing which is disposed a few cm away from the cavern wall and which terminates above the cavern floor. The cavern is sealed off from the atmosphere by a plug through which the supply and discharge lines extend. The lines extend to the gap between the casing and the cavern wall, and into the storage chamber. After venting of the cavern, water is forced into the gap by means of a gas under pressure. This water, and a layer of water which is still present above the cavern floor, is then frozen by means of a liquid refrigerant circulating through the cavern interior, the refrigerant boiling and evaporating. When the cavern is filled with high-pressure low-temperature natural gas, methane hydrates are formed in the open places of the casing by contact with the ice and seal the casing in a gas-tight manner relative to the surrounding rock. The casings can therefore be produced relatively cheaply since they do not have to be made completely gas-tight; even if cracking occurs in the casing or the ice layer, the formation of methane hydrate in the cracks will automatically seal them off. 4 figs.

0340 Combustion

Refer also to citation(s) 14391, 14445, 14758, 14759, 14760, 14763, 14765, 14775, 14845

14134 (ECN-C–90-059) **Catalytic combustion of natural gas: Technological aspects.** Kraehe, A.R. Netherlands Energy Research Foundation, Petten (Netherlands). Dec 1990. 49p. (In Dutch). Project NOVEM 42.320-001.2. Order Number DE91760600. Source: OSTI; NTIS (US Sales Only).

Under the authorization of NOVEM (Netherlands Agency for Energy and Environment) applications of catalytic burners have been listed by the Netherlands Energy Research Foundation (ECN). Also experiments were carried out in a high- and a low air surplus burner to determine the operational characteristics of the present ECN-developed catalytic combustor. Possibilities have been examined to use catalytic combustors for: direct and indirect heat supply for conventional purposes, direct and indirect heat treatment of products in the food industry, gas turbines, clean air production concerning the greenhouses, and for the purification of waste gases from the process industry and exhaust gases from gas engines. On each part of the NOVEM order reports have been written, which are published as the Appendices in a separate report, for which a separate abstract has been prepared. Summaries of the Appendices are presented. 8 figs., 4 tabs., 11 apps.

14135 (SVF–381) **Conversion of oil-fired boilers to natural gas - changes in efficiency and emissions.** Gustavsson, L. (Swedish National Testing Inst., Boraas (SE)). Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Nov 1990. 69p. (In Swedish). Order Number DE91763532. Source: OSTI; NTIS (US Sales Only).

A study of five oil-fired boilers which have been converted to natural gas have been carried out. The boilers have been both hot water boilers and steam boilers, with nominal heat outputs in the interval 0.3-6.0 MW. Measurements of boiler efficiency and emissions at different loads have been made before and after the conversion. Long-time measurement of the energy economy have been made in one case. The mean change in boiler efficiency has been recorded to an increase of 2-4% when converting to natural gas. This is verified by long-time measurements of energy economy in this and a coordinated experiment. The increase is mainly due to the fact that gas firing is almost free from soot formation, but also to that gas burners can be continuously regulated over a wide load interval. When compared with heavy oil firing, there is no energy demand for heating and circulating the oil, which increase the system efficiency with about 1.5%. The sulphur emissions was almost totally eliminated when using natural gas. The emissions of particulates were decreased by 75-85% when converting from heavy fuel oil to natural gas. The emission of nitrogen oxides in this case also decreased by 75-85%, whilst a change from light fuel oil decreased the emissions by 30-50%. (authors).

14136 Burner membrane. Bruyne, R. De. 29 Sep 1990. Filed date 15 Mar 1990. Canada Patent patent application 2012261. 22p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

Porous burner membranes for radiant burners are subjected to very strong temperature fluctuations that, over time, cause cracking in the membrane. This brings about the formation of preferential channels for fuel flow, causing blue flames and higher NOx emissions. An object of this invention is to avoid these drawbacks by providing sintered fiber-web membranes with a reduced tendency to degenerate. The membranes of the invention comprise a porous sintered web of inorganic fibers that are resistant to high temperatures, in which at least the membrane surface opposite the fuel supply side has been provided with grooves in the shape of a grid. The grooves bound the meshes of the grid, and the meshes are preferably regular polygons with a surface area of between 4 and 400 mm^2. The porosity of the membrane is between 70 and 90% and the permeability variation over its surface is less than 25%. The grooves constitute barriers to crack proliferation and divide the surface into small sections that can expand or contract in random directions. As material for the inorganic fibers, Al- and Cr-containing metal fibers are particularly suitable. Tests are described, illustrating the performance of membranes of the invention compared to conventional membranes when used in gas burners. 9 figs.

04 OIL SHALES AND TAR SANDS

0402 Reserves, Geology, and Exploration

Refer also to citation(s) 14054, 14101, 14173, 14174, 14183

14137 (IMMR–89/201, pp. 145-158) **Athabasca south: Resource characterization of an active in situ pilot area.** MacGillivray, J.R. (Alberta Research Council, Edmonton (Canada)); Wynne, D.A.; Keith, D.A.W.; Berezniuk, T.; Wightman, D.M.;

Berhane, H. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

The Lower Cretaceous McMurray/Wabiskaw Deposit (Athabasca Oil Sands) is the largest bitumen deposit in Alberta, Canada. The objective of this paper is to discuss the distribution of resources (bitumen and gas) in the southern region of this deposit (Townships 67-79, Ranges 1-18W4). The McMurray Formation sediments (fluvial to estuarine to marginal marine) infilled valley systems that were developed on the sub-Cretaceous unconformity. The fluvial sands (quartz arenites to sub-litharenites) at the base of the McMurray Formation are the best reservoir (little mud, amalgamated channel sands) although they do not have great lateral extent. Two valley systems are present and the northern part of the main (eastern) valley contains the thickest oil sands (more than 45 meters of >6 wt.% bitumen). An abrupt bitumen/water contact occurs in the east along a Paleozoic escarpment created by the dissolution of underlying Devonian salts. The secondary valley consists of thinner oil sands (less than 20 meters of >6 wt.% bitumen) with a gradational bitumen/water contact trending east/west. Both valley systems are locally underlain by bottom water or contain water sands. A gas field is present in the northeast. The Wabiskaw Member (Clearwater Formation) sands (litharenites) conformably overlie the McMurray Formation and were deposited in a marginal marine setting as the Boreal Sea transgressed from the north. These sands differ mineralogically from the McMurray Formation and have greater lateral continuity. The best Wabiskaw Member sand, from a resource viewpoint, was developed in the east-central area (over 35 meters of >6 wt.% bitumen). This sand dips gradually to the southwest and has a gap cap in its updip end. Structure, facies, and bitumen biodegradation were all major factors in the bitumen trapping.

14138 (IMMR–89/201, pp. 232) **Organic geochemistry, petrography, and maturation trends of the Ohio shale in eastern Kentucky.** Rimmer, S.M. (Univ. of Kentucky, Lexington (USA)); Cantrell, D.J.; Gooding, P.J. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Organic petrographic and geochemical data indicate a southeastwards increase in maturation of the Ohio Shale (Devonian-Mississippian) within Kentucky. Reflectance levels of dispersed organic material in the Cleveland Shale increase from 0.5% in the outcrop belt in central Kentucky, to slightly over 1.0% in Pike County, eastern Kentucky. Similar reflectance trends are observed in other shale units including the Upper and Lower Huron. A decrease in fluorescence intensity of liptinitic components, such as Tasmanites, accompanies this reflectance increase, as does a shift in fluorescence color towards the red. In the highest rank areas of eastern Kentucky, fluorescence is almost absent. Kerogen in the Cleveland Shale is primarily Type II, as indicated by petrographic observations and Rock-Eval data. TOC contents of this shale decrease from over 12% in the outcrop belt, to less than 2% in Pike County, eastern Kentucky. Tmax values for this unit range from under 430 degrees C in the outcrop belt, to over 450 degrees C in eastern Kentucky, confirming the increase in maturation trends indicated by the reflectance data.

14139 (IMMR–89/201, pp. 233-238) **Organic geochemistry and organic petrology of Paleozoic oil shales in Canada.** Goodarzi, F. (Geological Survey of Canada, Calgary, Alberta (Canada)); Fowler, M.G.; Nassichuk, W.W. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Several Paleozoic oil shales, ranging in age from Ordovician to Carboniferous, occur in many different parts of Canada. These oil shales are of marine and nonmarine origin and therefore show diverse geochemical and petrological characteristics which will be discussed here. Oil shales of Ordovician age include the Collingwood oil shale of southern Ontario and various deposits in the eastern Arctic Islands including one in the Boas Formation on Southampton Island. The Collingwood consists of mostly type II amorphous organic matter deposited under marine conditions. Although the Boas also contains type II amorphous organic matter, biomarker evidence suggests that it may have been deposited under hypersaline conditions. The Devonian Marcellus and Kettle Point formations of Ontario contain oil shales of marine origin. Organic matter in the Devonian deposit are often dominated by large Tasmanales algae. Carboniferous oil shale deposits are widespread in the Atlantic provinces and include the Alberta Shale of New Brunswick, the Pictou Group of Nova Scotia and the Rocky Brook Formation of Newfoundland. Most of these deposits are associated with lacustrine conditions and Botyroccocus brauni is a major contributor to their organic matter. The Carboniferous Emma Fiord Formation on Devon Island in the Canadian Arctic Archipelago is another rich oil shale deposited under lacustrine conditions.

14140 (IMMR–89/201, pp. 239-252) **Directions and characteristics of jointing in the New Albany shale (Devonian-Mississippian) of southeastern Indiana.** Ault, C.H. (Indiana Geological Survey, Bloomington (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

More than 1,200 measurements of joint orientations at 27 sites in the New Albany Shale (Devonian-Mississippian) were made in an 850-square-mile study area in southeastern Indiana. The measurements show that primary jointing is east-northeastward and that secondary jointing is mostly north-northwestward. Joints in the thin-bedded New Albany Shale are vertical or nearly vertical, and the most prominent primary joints are commonly spaced 1.5 to 6 feet (0.5 to 2 m) apart but are variable from bed to bed within the New Albany and from site to site. Although the observed lengths of most primary joints are limited by the dimensions of the exposed bedrock, some prominent joints can be traced for more than 1,300 feet (396 m). Secondary joints are much less prominent, much shorter, less linear, and more variable in direction. Many butt against primary joints. Some joints extend vertically into the overlying Rockford Limestone (Mississippian), and some extend into the underlying North Vernon Limestone (Devonian). The jointing orientation is controlled mostly by contemporary crustal stress, which is the predominant control of jointing orientation in much of Indiana and adjacent states. A knowledge of fracture directions is needed to help determine directions of fluid and gas transmission in the shale and possible communication with fluids in adjacent rock units; to help predict artificial fracture patterns caused by explosives or hydrofracturing; to help resolve directions of ground-water influx into drill holes and mines; and to help design future surface and underground mines.

14141 (IMMR–89/201, pp. 253-268) **Pyroclastic mineral euhedral horizons in eastern United States Devonian oil shales.** Conkin, J.E. (Univ. of Louisville, KY (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Internal units of the Late Devonian black shales (New Albany-Chattanooga-Ohio) are recognizable on the bases of essentially chronostratigraphic disconformities of the magnitude of paracontinuities and their associated bone beds, which resulted from rapid physical transgressions, but essentially non-geologic time transgressive, cratonic marine pulsations. Three of these bond beds (14-16), immediately overlying paracontinuities 15-17, respectively, bear pyroclastic mineral euhedral horizons (unnamed one at base of Blocher-lower Dowelltown; Belpre at base of Selmier-upper Dowelltown; and Center Hill at top of upper Dowelltown and/or base of lower Gassaway and its correlatives) which function as a time framework within these Late Devonian black shales. Bone bed 16 at base of Morgan Trail-lower Gassaway represents the position of the Center Hill Metabentonite outside its type locality area of the Eastern Highland Rim of Tennessee. The correlatives of these

three pyroclastic horizons are identifiable in southern Indiana, northeastern Kentucky, and Ohio either by their possession of pyroclastic mineral euhedra or by their stratigraphic-paleontologic context. An alternative explanation for the presence of pyroclastic mineral euhedra in bone beds 14 and 15 is that they represent reworking from previously existing pyroclastic horizons; however, the Center Hill Metabentonite (expressed mostly as a weathered biotite tuff in its type area of the Eastern Highland Rim of Tennessee) is represented in the Northern Highland Rim of Tennessee and southern and northwestern Kentucky by the same kinds of pyroclastic mineral euhedra as are present in bone beds 14 and 15, mostly zircon, bipyramidal quartz, apatite, and rarely biotite.

14142 (IMMR–89/201, pp. 539) **Relationship of New Albany shale (Devonian-Mississippian) and Rockford Limestone (Mississippian to Silurian) in Greene County, Indiana.** Hasenmueller, N.R. (Indiana Geological Survey, Bloomington (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

The structure on top of the carbonate rocks of the Muscatatuck Group (Middle Devonian) indicates two small isolated Silurian pinnacle-type reefs, the Dixon Reef and the Lyons West Reef, and one larger coalesced reef, the Switz City Reef in Greene County. On the crests of the three reef-associated structures the New Albany thins by as much as 25 feet, and the Rockford Limestone (Mississippian) is absent in most places. The change in thickness is significant and is probably the result of thinning in two ways: (1) loss distributed throughout the entire shale interval may be the result of differential sedimentation and (or) subaqueous erosion of New Albany sediments above the buried reefs, and (2) loss largely confined to the uppermost part of the formation may be the result of subaqueous erosion of the shale during post-Rockford and pre-New Providence (Mississippian) time. The continued growth of reef-induced drape structure during a period of extremely slow sedimentation, which existed during the Late Devonian and Early Mississippian, could have resulted in topographic expression on the sea floor above the buried reefs. Differential sedimentation over these topographic highs could have caused variations in the thicknesses of sediments deposited during New Albany time. Scouring of the topographic highs by currents during Middle Mississippian time could have resulted in subaqueous erosion of lithologic units on the crests and caused the unconformity between the New Albany and New Providence over the reef structures.

0403 Drilling, Fracturing, and Mining

Refer also to citation(s) 14182

14143 (IMMR–89/201, pp. 303-314) **Water-jet assisted mechanized oil shale mining factor tests.** Kogelmann, W.J. (Alpine Equipment Corporation, State College, PA (USA)); Thimons, E.D.; Virgona, J.E.; Weakly, L.A. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

The objective of this study is to evaluate the water-jet-assisted (WJA) mechanical cutting of oil shale under actual mining conditions. The cost of the 24-month, three-phase Technology Development Project, started in February 1988, is shared equally between Alpine and the Department of Energy. Alpine has designed and manufactured a standard-sized roadheader (boom-type continuous miner) for water-jet-assisted (WJA) factory cutting tests. This WJA rock miner is being used for testing of novel PDC diamond cutting tools and of high-pressure-water (HPW) components to be incorporated in a heavy-duty, high-production WJA mechanized mining machine. Field testing of the machine will be conducted in an underground oil shale mine located in the Piceance Basin of western Colorado. Additional support will be provided by the U.S. Bureau of Mines Pittsburgh Research Center and oil shale companies, through the Colorado Mining Association. The novel PDC diamond bits (picks), especially the rotating point-attack bits with semi-round domed PDC inserts, showed excellent impact resistance and outstanding wear characteristics when compared to standard tungsten-carbide (carbide) tools. Water-jetting considerably reduced dust levels and increased tool life. However, the water-jets could not penetrate oil shale, a dense dolomitic limestone with kerogen, even at high water pressure and at low traversing speed (i.e. a slow cutter head rotation). No significant reduction of cutting forces through water-jet-assist was observed. In order to control dust and cool the cutter bits for increased tool life, a water pressure of up to 207 bar (3,000 psi) seems to be adequate. In order to further reduce pressure and thus water flow, the use of through-flush cutter bits is being investigated.

0404 Oil Production, Recovery, and Refining

Refer also to citation(s) 14172, 14175, 14182, 14980

14144 (CONF-9004103–3) **Pressurized fluidized-bed hydroretorting of Eastern oil shales.** Lau, F.S.; Roberts, M.J. Institute of Gas Technology, Chicago, IL (USA). [1990]. 24p. Sponsored by Institute of Gas Technology, Chicago, IL (USA). From Oil shale and tar sand contractors review meeting; Morgantown, WV (USA); 18-19 Apr 1990. Source: OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616.

The overall objective of the program is to generate a data base for developing a pressurized fluidized-bed hydroretorting (PFH) process for producing oil from Eastern oil shales. The program also incorporates research on technologies in areas such as raw shale preparation, beneficiation, product separation, and waste utilization and disposal that have the potential for improving the economics and/or the environmental acceptability of the PFH process. 8 refs., 7 figs., 1 tab.

14145 (IMMR–89/201, pp. 5-10) **Experience in the beneficiation of two Alabama tar sands.** Schultz, C.W. (Univ. of Alabama, Tuscaloosa (USA)); Cardoso, J.B.; Irvin, G.D. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

Tar sand samples were collected from sites in Colbert and Lawrence counties in northern Alabama at sites known as Spring Creek and Black Wax Hill. Toluene extractions indicated bitumen contents of 8.3 and 8.6 percent respectively. Further characterization revealed that the Black Wax Hill sampled had a higher clay content and a finer mineral matter matrix. The Spring Creek tar sand responded better to flotation than did the Black Wax Hill sample. At all conditions tested, the Spring Creek sand yielded concentrates of higher bitumen content and higher bitumen recovery. The difference in response is attributed to the differences in physical characteristics. Process optimization studies showed that an attrition scrubbing step, between grinding and flotation, markedly improved both the quality of concentrate and the recovery of bitumen. Concentrates containing 31 percent bitumen with 87 percent bitumen recovery were achieved.

14146 (IMMR–89/201, pp. 11-17) **Extraction of Alabama tar sands with heptane and carboxylic acid mixtures and using a saponification cycle.** Ulrich, R.K. (Univ. of Arkansas, Fayetteville (USA)); Koppaiah, M.K.; Majmudar, V.K. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

A tar sands extraction process is being developed that requires a heptane/oleic acid mixture to be used as the solvent. This paper is a description of the issues and problems involved in using this mixture in the contactor and the sand cleanup units of a generic tar sands processing plant. The optimal solvent composition was determined to be 70 vol % heptane and 30% oleic acid. A rotating disk method was used to determine that the solvation rate of bitumen into this solvent was sufficient for use in conventional contacting schemes. Spring Creek bitumen was 96 wt % soluble in this mixture. The phase behavior of a saponification cycle for sand cleanup was investigated and the reagent streams optimized.

14147 (IMMR–89/201, pp. 18-25) **Uses of generated surfactants from a new tar sand process for extracting hydrocarbons from natural and man-made materials.** Sadeghi, K.M. (Univ. of Southern California, Los Angeles (USA)); Sadeghi, M.A.; Yen, Teh Fu. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

A process has been developed to generate self-propagated surfactants during bitumen recovery from tar sand using alkaline solution under ultrasonic energy. During the process, bitumen that floated to the top of the solution was found to be upgraded and free of asphaltene and pre-asphaltenes. The asphaltic part of the bitumen was shown to have dissociated into the solution in the form of vesicles due to interaction with amphiphiles. The multi-lamellar surfactant vesicles, which remain very stable for many years, have the capacity to extract hydrocarbons from virtually any source. This paper illustrates that these highly-efficient surfactants can remove bitumen from tar sand (Kentucky, California, Athabasca) and hydrocarbons from oil spills on land (Valdez oil spills), as well as clean oily soil (petroleum-contaminated soils). These data show a high efficiency in extracting hydrocarbon within minutes under sonication in an alkaline solution with addition of a trace free radical (H_2O_2). The mechanisms are related to membrane-mimetic chemistry.

14148 (IMMR–89/201, pp. 26-39) **Selection, design, and scale-up of equipment to extract bitumen from tar sands.** Penney, W.R. (Univ. of Arkansas, Fayetteville (USA)); Ulrich, R. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Extraction equipment for solvating bitumen from tar sands must satisfy certain process requirements, including: agitation of solids (fed from the mining and the crushing operations) to effect dissolution of interstitial bitumen and release individual grains of sand, wash the sand free of bitumen to prepare the sand for solvent recovery, and isolated any fines from the solvated bitumen phase and wash them in preparation for solvent recovery and eventual environmentally acceptable disposal, either alone or with the clean sand. Many different processing schemes have been proposed for solvent extraction of the bitumen and all of them in some fashion effect countercurrent flow of the solvent and sand. These schemes include: a series of sloped vessels containing augers, a series of rod or ball mills, a countercurrent moving bed in a vertical vessel, a compartmented, agitated, vertical vessel, rotary drum mixer followed by countercurrent washing of sand in moving beds, a series of agitated vessels and screens, and an agitated vessel followed by a countercurrent wash in a series of hydroclones. The potential advantages and disadvantages of all these are discussed along with selected other schemes. The handling of fines which could remain with the solvent-bitumen phase is an important consideration. An inclined plate gravity settler or a disk centrifuge are logical choices to contain fines within the extraction system. Means of handling fines, either for separate discharge or co-discharge with the sand, are discussed.

14149 (IMMR–89/201, pp. 40-49) **The role of organic matter complexes in oil sand processability and sludge formation.** Kotlyar, L.S. (National Research Council, Ottawa, Ontario (Canada)); Sparks, B.D. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Presently hot water extraction technology is being used in Canada to separate bitumen from oil sands recovered by strip mining. Unfortunately, Canadian oil sands deposits contain appreciable amounts of fine solids which, during processing, form an aqueous dispersion containing a significant amount of bitumen. This dispersion eventually stabilizes as a highly structured sludge which resists compaction, even during prolonged storage. It has been observed that considerable quantities of strongly bound organic matter (SOM) are associated with certain well defined solids fractions that can be separated from the sludge. These fractions which have also been observed in unprocessed oil sand feed samples are believed to play a role, not only in the processability of oil sands feed, but also in the intractability of sludge with respect to its compaction and settling properties. Consequently, it is desirable to gain a deeper insight into the nature of these components in both oil sand feed and sludge, in order to better understand their involvement in sludge build-up.

14150 (IMMR–89/201, pp. 50-61) **Low temperature oxidation strategy for increasing the effectiveness of hot fluid recovery of bitumen - an experimental study.** Ivory, J. (Alberta Research Council, Edmonton (Canada)); Toma, P.; Coates, R.; DeRocco, M.; Livesay, D. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

This paper presents results from laboratory experiments which involved the recovery of bitumen by the injection of hot water and air. Air commingled with hot water was injected continuously or in slugs. The effectiveness of air in enhancing the hot water recovery process and the major mechanisms involved in the recovery process were assessed using oil production, pressure drop and pH data as well as temperature distributions. Properties of produced fluids and residual oil were monitored including viscosities, asphaltene, sulfate, acetate and total inorganic carbon content. An oil sand pack, which had a diameter of 0.25 m and was 1 m long and contained an axial communication path, was used during this study. In addition, core size experiments were performed. A substantial increase in final oil recovery from 13 to 58% of the initial oil in place was detected in the 1 m long oil sand pack. In the core experiments, air reduced the residual oil saturation from 34% to 16%. The experiments indicated that: (1) low temperature oxidation was active at the edge of the recovery front where a significant temperature increase was observed during air injection, (2) because of changes resulting from low temperature oxidation reactions, the resistance to fluid flow through pore throats was increased and resulted in an increased pressure drop, (3) increased flow resistance in the communication path of bypass zones resulted in the diversion of hot fluids and enhanced bitumen production, (4) if air is injected too late, i.e. when the water-only recovery process is declining, its effect is less significant.

14151 (IMMR–89/201, pp. 86-97) **Volatile compound evolution from programmed temperature pyrolysis of Big Clifty and McKittrick tar sands at 10 C/min heating rate.** Reynolds, J.G. (Lawrence Livermore National Laboratory, CA (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Big Clifty (Kentucky) and McKittrick (California) tar sands wee pyrolyzed at a 10°C/min heating rate from room temperature to 900°C. The volatile compounds were detected on-line and in real time by tandem mass spectrometry using MS and MS/MS detection. Evolution of hydrocarbons and heteroatomic-organic species occurs in two regimes: (1) low temperature (T_{max} values of 158 to 197°C), corresponding to entrained organics, and (2) moderate temperature (T_{max} values of 435 to 500°C), corresponding to cracking of hydrocarbons. Methane has slightly higher T_{max} values of 526 and 502°C for Big Clifty and McKittrick tar sands, respectively. In almost all cases for individual hydrocarbons, the T_{max} values for Big Clifty tar sand are several degrees higher than the corresponding T_{max} values for McKittrick tar sand. H_2 exhibits evolution in three temperature ranges: hydrocarbon cracking, secondary char (550 to 650°C), and high (above 650°C). Both tar sands have similar profile behavior. Except for a very small amount evolving at hydrocarbon cracking temperatures, CO evolution is dominated by high temperature complex gas-equilibrium chemistry for both tar sands. The CO_2 profiles are, however, distinctly different with Big Clifty being dominated by high temperature evolution (probably carbonate decomposition). H_2S profiles were also distinctly different. The Big Clifty profile exhibited evolution in the hydrocarbon cracking temperature range, and in the range for

FeS_2 decomposition. The McKittrick profile was dominated by a large, broad maximum in the low temperature range.

14152 (IMMR–89/201, pp. 205-211) **Western oil shales attrition and breakage: Testing and mineral characterization.** Grimm, U. (Morgantown Energy Technology Center, WV (USA)); Swaney, G. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Retorting oil shale weakens the structural strength of the material and causes the formation of fines which are carried out of the reactor and can significantly deteriorate the quality of the products. The goal of this work is to develop, in a systematic manner, a predictive model based on fracture experiments and process properties. Preliminary work using simple drop shatter tests has been conducted with two western oil shales. Their Fischer assay values were 23 and 65 gal/tons. The breakage behavior was investigated on material which had been exposed to temperatures between ambient and 1,000°C. In this range the oil shale materials undergo several chemical and physical changes. These are the pyrolysis of the organic compounds, the calcination of dolomite, and, possibly, the burnout of residual char to generate heat for the retorting process. The onset of sintering of the spent shale material in this range is apparent. Accompanying changes in the mineral composition were studied by X-ray diffraction. The drop shatter tests were designed to acquire fundamental design information for the construction of a more advanced test apparatus which allows single particle breakage testing under process temperatures and atmospheres. The hot impact tester (HIT) will investigate fracture attrition of shales by impacting single, hot shale particles with a high-speed pneumatic piston.

14153 (IMMR–89/201, pp. 212-218) **Changes in the clay mineralogy of eastern oil shale induced by retorting.** Robl, T.L. (Univ. of Kentucky, Lexington (USA)); Rubel, A.M.; Barnhisel, R.I. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

The mineralogy of several eastern oil shales have been examined, including: samples from the Cleveland member of the Ohio Shale, the New Albany Shale, and the Sunbury Shale. Retorted eastern oil shales from pilot tests of the Dravo Traveling Grate Retort, Petrobras' Petrosix Retort, the KENTORT II Retort and a series of spent shales from fixed bed experiments, performed across a range of temperatures, were also examined. The oil shales were composed primarily of clays (70-80%), with lesser quartz (10-25%), and sulfides (2-5%). The clays included illite (61-71%), chlorite (3-11%) and kaolinite (3-7%), with minor amounts of vermiculite and smectite (<4%). The raw and retorted shales were extracted with dilute (6N) H_2SO_4 to measure the effects of mineralogic transformations on the chemical reactivity of the materials. The principal effects of retorting on the shales was the decrystallization of kaolinite, the partial decrystallization of illite, and the transformation of pyrite to pyrrhotite. Illite decrystallization correlated with processing temperature. The attenuation of the illite 001 peak was directly correlatable to the acid solubility of Al and K. The solubility of Fe was proportional to the degree of pyrite conversion to pyrrhotite. Fe solubility was reduced by the conversion of the iron sulfides to oxides.

14154 (IMMR–89/201, pp. 293-302) **Examination of wet- and dry-sieved eastern oil shale and microbial reduction in its sulfur content.** Krieger, E.J. (Ohio State Univ., Columbus (USA)); Pfister, R.M.; Ridge, J.R. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Eastern oil shale represents a large source of potential energy. However, the relatively high amount of sulfur and nitrogen it contains renders widespread oil production from this source economically and environmentally unfeasible. Therefore, it would be useful to develop biological methods to reduce the amount of these elements in the shale prior to processing. A variety of microorganisms have been enriched from crushed Indiana New Albany oil shale in defined media limited with respect to available sulfur and/or nitrogen. Analyses of freshly ground shale in an electron microscope have indicated the presence of a relatively high number of microorganisms and particles of various sizes. Greater than 70% of the fractions of freshly ground and beneficiated shale collected by common dry-sieve sizing are larger than 325 mesh, whereas when wet-sieved, > 70% of the fractions are smaller than 325 mesh. The samples of −325 mesh shale particles have a significantly higher concentration of sulfur than larger particles as determined using an energy dispersive x-ray fluorescence spectrometer. Treatment of ground shale with 5.0 M HNO_3 results in 50-80% reduction of sulfur present correlated to particle size. Exposure of pretreated shale to a mixed culture inoculum results in approximately 5-12% further reduction in sulfur depending on particle size and medium composition.

14155 (IMMR–89/201, pp. 316-323) **Eastern oil shale attrition and breakage: Testing and modeling.** Grimm, U. (Morgantown Energy Technology Center, WV (USA)); Swaney, G. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

While some work has been done on the attrition of oil shales at room temperature or in a specific process, no generalized study has been conducted at the high temperatures typically encountered in a retorting process. To facilitate these studies, a rolling attrition tester (RAT) has been designed and constructed. It consists of a 10-inch diameter drum suspended and rotating in an electric furnace at temperatures up to 1,000°C. Tests have been run on raw and pyrolized eastern oil shale obtained from the Cleveland Seam in Bullitt County, Kentucky. Similar to the results of earlier drop tests, the attrition is most prevalent near the normal retorting temperature of 400-600°C. The matrix method of Broadbent and Callcott for coal grinding and breakage has been adapted to model the hot attrition results. Since the RAT performs multi-particle tests, the resulting breakage matrix also contains information on probability and selection for breakage. A general attrition prediction method is proposed which is based on the breakage matrix of the material and the intensity and frequency of the collisions in the process.

14156 (IMMR–89/201, pp. 405-410) **Prediction of particle size distribution for eastern oil shales using the self similarity approach.** Mehta, R.K. (Univ. of Alabama, Tuscaloosa (USA)); Schultz, C.W.; Irvin, G.D.; Bates, J.B. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

The physical beneficiation of oil shale requires grinding the shales to an extremely fine particle size range to ensure effective liberation of the kerogen. This paper offers a simple scheme based on the self similarity approach for predicting the complete size distribution of the ground product. It is shown that the self-similar characteristic curve is unique to the combination of feed oil shale and mill type but independent of the mill operating conditions. The characteristic particle size (d_{50}) used in constructing the characteristic curve (nondimensionalized particle size distribution curve i.e. F_3 (d) v/s d/d_{50}) can be predicted by a modified Charles energy-size reduction relation (E v/s d_{50}). Therefore, using the characteristic curve, the complete particle size distribution of the ground oil shale for a given specific energy input to the size reduction device can be made.

14157 (IMMR–89/201, pp. 411-416) **Pressure cycle comminution of eastern oil shale.** Misra, M. (Univ. of Nevada, Reno (USA)); Paoli, M.; Rao, M. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Separation of kerogen from eastern oil shale can be accomplished by find grinding followed by froth flotation. Fine grinding is

energy intensive. It is estimated that 40-45 kWh/ton of energy is required for grinding oil shale to minus 10 micron size by high speed ball mill whereas the energy demand is in the range of 90-100 kWh/ton for conventional ball mill grinding. In this study, an energy efficient pressure cycle comminution technique is used for grinding oil shale. In pressure cycle grinding, the energy required to break the particle is applied directly into the particle. As a result, particle breakage can be achieved at a substantially lower energy input as compared to high speed and conventional ball mill. The effect of various parameters such as permeability, porosity, saturation time and applied pressure on the process performance has been discussed. The synergistic effect of surface energy modifiers for the comminution of oil shale has been experimented. The results of thee experiments are tabulated and conclusions are drawn.

14158 (IMMR–89/201, pp. 417-424) **Application of Licado process to eastern oil shale.** Venkatadri, R. (Univ. of Pittsburgh, PA (USA)); Morsi, B.I.; Chiang, S.H. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

The LICADO process is a novel beneficiation process developed at the University of Pittsburgh. It is a surface-property driven process in which the liquid CO_2-water interface is used for the differentiation and separation between the kerogen-rich shale and mineral matter. The process is carried out at room temperature and a pressure of about 850 psig. Prior to carrying out beneficiation tests, contact angle measurements were conducted at atmospheric pressure as well as at elevated pressures. These experiments revealed that the surface of oil shale was rendered hydrophobic by liquid CO_2. A 2-inch Batch Research Unit was utilized to study the influence of various operating parameters on the product quality as well as oil recovery of Indiana and Alabama shales. The effect of various dispersants was examined. Additional experiments were conducted in a modified Batch Research Unit where the upgraded product was captured on a screen. Tests were also performed in a semi-continuous mode.

14159 (IMMR–89/201, pp. 425-430) **Column flotation of eastern oil shales.** Schultz, C.W. (Univ. of Alabama, Tuscaloosa (USA)); Bates, J.B.; Lamont, W.E. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Column flotation tests were performed on Devonian shale samples from Alabama, Indiana, Kentucky, Ohio, Michigan, and Tennessee. All samples tested required ultrafine grinding to yield acceptable products. They did, however, show distinctive differences in their behavior in flotation. A comparison of the results achievable in laboratory column cells and mechanical flotation cells is made. The data show that in most cases, single stage column flotation is equal to multiple stages of conventional flotation. The effect of certain column operating and design parameters was investigated in some detail. Parameters investigated included point of feed addition, froth height, column height, air rate, bubble size, and wash water rate. The results indicated that the column height may be a dominant design parameter and that more collection may occur in the froth phase than is commonly believed.

14160 (IMMR–89/201, pp. 447-457) **Petrobras boosts oil shale fines processing.** Lisboa, A.C. (Petroleo Brasileiro, Sao Mateus do Sul (Brazil)); Novicki, R.E.; Piper, E.M. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

The Petrobras oil shale retorting process, PETROSIX, utilizes the particle range of +1/4 inch-3 1/2 inches. However, the nature of the raw oil shale is such that the amount of shale less than 1/4 inch that is mined and crushed and returned to the mine site is about 20 percent. Petrobras has investigated several systems to process the fines that are not handled by the 65 MTPH UPI plant and the 260 MTPH commercial plant. The first is the PLASOL entrained bed process to extract oil and fuel gas. This low residence time, high heating rate process, depletes oil shale completely of its original potential oil and gas. Both steam and recycle gas have been used for processing gas. The set of data gathered under several operating conditions led to the process optimization. The second is the spouted bed retorting process. A 250 kgh pilot plant has been used to retort the particles employing air as the spouting fluid. Under this mode of operation, the retorting heat can be wholly provided by partial combustion of the organic matter inside the bed, thus eliminating any external heating. The major feature of this technology is to handle the oil shale fines as they are discharged at the PETROSIX solid preparation plant, without any further drying or crushing. Another feature of this system is the ability to process oil shale sludge to recover Btu values. The third is the circulating fluidized bed (CFB) boiler. The burning of oil shale fines is a convenient source of heat and steam to meet plant requirements. This paper provides an updated status of each of these processes in regard to the tests performed, potential contributions to an integrated use of the oil shale mine, and future considerations.

14161 (IMMR–89/201, pp. 471-479) **Microbial desulfurization of Eastern oil shale: Bioreactor studies.** Maka, A. (Institute of Gas Technology, Chicago, IL (USA)); Akin, C.; Lau, F.; Srivastava, V.; Punwani, D.V. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

The removal of sulfur from Eastern oil shale (40 microns particle size) slurries in bioreactors by mixed microbial cultures was examined. A mixed culture that is able to remove the organic sulfur from model sulfur compounds present in coal as well as a mixed culture isolated from oil shale enrichments were evaluated. The cultures were grown in aerobic fed-batch bioreactors where the oil shale served as the source of all nutrients except organic carbon. Glucose was added an an auxiliary carbon source. In this study, microbial growth was monitored by plate counts, the pH was checked periodically, and oil shale samples were analyzed for sulfur content. Results show a 24% reduction in the sulfur content of the oil shale after 14 days. For the efficient microbial removal of sulfur from oil shale, the shale particles and microbes should remain suspended in the bioreactor. The settling characteristics of the oil shale in the bioreactors were examined in the presence of the microbes. Also, the mixing characteristics of the oil shale in the bioreactors were examined. Generally, a mixing rate of 300 rpm resulted in a uniform shale particle concentration at different levels in the bioreactor and an increased microbial growth.

14162 (IMMR–89/201, pp. 480-486) **Nitrogen chemistry during oil shale pyrolysis.** Oh, M.S. (Lawrence Livermore National Laboratory, CA (USA)); Foster, K.G.; Alcaraz, A.; Crawford, R.W. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Real time evolution of ammonia (NH_3) and hydrogen cyanide (HCN), two major nitrogen-containing volatiles evolved during oil shale pyrolysis, was measured by means of a mass spectrometer using chemical ionization and by infrared spectroscopy. While the on-line monitoring of NH_3 in oil shale pyrolysis gases was possible by both techniques, HCN measurements were only possible by IR. The authors studied one Green River Formation oil shale and one New Albany oil shale. The ammonia from the Green River oil shale showed two distinct peaks, while the New Albany shale showed one broad NH_3 peak maximizing at a high temperature. For both oil shales, most NH_3 evolves at temperatures above oil-evolving temperature. The important factors governing ammonia evolution were the presence of inorganic ammonium salts such as Buddingtonite in Green River oil shales, the distribution of nitrogen functional groups in kerogen, and the retorting conditions. The gas phase reactions, such as NH_3 decomposition and HCN conversion reactions, also play an important role in the distribution of nitrogen volatiles, especially at high temperatures. Although pyrolysis studies of model compounds suggests the primary nitrogen product from kerogen pyrolysis to be HCN at high temperatures, the

authors found only a trace amount of HCN at oil-evolving temperatures and none at high temperatures (T > 600°C).

14163 (IMMR–89/201, pp. 487-498) **Pressurized fluidized-bed hydroretorting of Indiana New Albany shale in batch and continuous reactors.** Roberts, M.J. (Institute of Gas Technology, Chicago, IL (USA)); Rue, D.M.; Lau, F.S.; Roosmagi, C. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Work is being conducted at the Institute of Gas Technology (IGT) with U.S. Department of Energy (DOE) support to develop a pressurized fluidized-bed hydroretorting (PFH) process for the production of oil from Eastern oil shales. The PFH process, using smaller particle sizes than the moving-bed hydroretorting process, offers higher oil yields and greater reactor mass fluxes through higher selectivity of organic carbon to oil and shorter residence times, respectively. Batch PFH tests have been conducted to study the effects of shale preheat time (15 to 30 min) and temperature (25° to 320°C), retorting temperature (450° to 710°C), hydrogen pressure (2.8 to 7.0 MPa), particle size (65 to 330 microns), and residence time (5 to 30 min) on the product yields from Indiana New Albany shale. Oil yield has been found to increase with increasing hydrogen pressure. The oil yield was observed to have a maximum at 480°C and to decrease slightly with increasing temperature. At 7.0 MPa hydrogen, the highest oil yield obtained was 130 l/ton (31 gal per ton or 215% of Fischer Assay). Hydrocarbon gas production was found to increase with increasing temperature, but was unaffected by pressure. Decreasing residence time from 30 to 5 minutes had no effect on oil yield but decreased gas yield. Continuous PFH reactor tests produced oil yields and carbon distributions similar to those from the batch tests.

14164 (IMMR–89/201, pp. 499-510) **Fluidized-bed retorting of eastern oil shale.** Gaire, R.J. (Foster Wheeler USA Corporation, Clinton, NJ (USA)); Mazzella, G.; Hand, T.J. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Under contract to the U.S. Department of Energy, Foster Wheeler developed the conceptual design and economics for an integrated plant to produce 50,000 BPD of syncrude from eastern New Albany oil shale. Objectives of this work were to provide detailed technical and cost information which would serve as a reference data base for DOE and to identify areas where future development is required to realize any potential economic benefits. The processing scheme was based on fluidized-bed retorting of eastern oil shale at atmospheric pressure with recycle of hot shale solids to supply the heat required for pyrolysis. Essentially complete utilization of the shale energy content was accomplished via combustion of the retorted shale in fluidized-bed boilers. In addition to a high quality syncrude, the integrated plant produces substantial amounts of electric power and sulfuric acid as co-products. Designs for the retorting and downstream processing systems were based on non-confidential published information with supplementary input from process licensors. The integrated plant design is described in terms of the component process units and support systems and the estimated plant investment is detailed by the individual plant sections. Annual operating costs and the corresponding production costs for syncrude product are highly dependent on the assigned values for co-products. Accordingly, the syncrude production cost could be in the range of $35 per barrel. The syncrude economics are compared with those developed by Foster Wheeler for processing Colorado oil shale, as well as with published estimates for hydro-retorting of eastern shale.

14165 (IMMR–89/201, pp. 511-518) **Operation of the 5-lb/hr KENTORT II reactor in the solid recirculation mode.** Carter, S.D. (Univ. of Kentucky, Lexington (USA)); Taulbee, D.N. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Of great importance to the development of the KENTORT II process is the abatement of oil yield losses caused by direct, solid-solid heat transfer in the pyrolyzer. It is not practical to transfer heat to the pyrolysis zone of the KENTORT II process exclusively with hot gases at the commercial scale. This is due to the relatively low heat capacity of gases and the cross sectional area and superficial gas velocity limitations of fluidized beds. Recirculating hot shale is the most straightforward method of transferring heat to the pyrolysis zone, but it has the potential to significantly reduce oil yields due to coking. Therefore, the primary objectives of this study were to: (1) evaluate the effects of recycle solid temperature, recirculation ratio, and solid type on oil yield and composition in the 5-lb/hr integrated reactor, and (2) investigate methods of reducing oil yield losses. Solids from the integral gasification section were recirculated to the pyrolysis zone to provide a portion of the heat required for pyrolysis. The recirculating shale from the gasifier had been subjected to either pyrolysis/gasification or pyrolysis/gasification and combustion. Preliminary results indicate that oil yield losses using the pyrolysis/gasification material are reduced if a low temperature recycle stream with a relatively high solid recycle rate is used for a given pyrolysis heat demand. Oil yields remained 15% above the Fischer assay oil yield under the highest pyrolysis heat load conditions when utilizing the low temperature/high recycle ratio combination. The influence of combusted shale is currently under investigation.

14166 (IMMR–89/201, pp. 541) **Characterization of particulates in oil sands processing streams.** Mikula, R.J. (CANMET, Devon, Alberta (Canada)); Lam, W.W.; Munoz, V.A. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

The Clark hot water process is used in the industrial extraction of bitumen from Alberta oil sands. The goal of the extraction process is to remove bitumen from the solids and water of the oil sands, which becomes feed in the upgrading processes to produce synthetic crude oil. Characterization of solids at various conversion stages is critical to the efficient operation of the downstream processes. For example, it has been shown that high proportions of fine clays contribute to poor initial extraction of bitumen from the oil sands. Further downstream, the presence of particulates above a certain size range might indicate failure of a fine mesh screen in a unit process, or the source of particulates in a certain recycle or feed stream. The combination of scanning electron and optical microscopy, and image analysis has been utilized to determine both the nature and size distribution of oil sands particulates. Electron and optical microscopy are complimentary techniques in that the former is most useful in determining the chemical composition of mineral components, and the latter is used for the determination of coke and other organic solids.

14167 (UCID–16986-90-3/4) **Oil shale quarterly report, August–December 1990.** Cena, R. Lawrence Livermore National Lab., CA (USA). 15 Feb 1991. 46p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91009722. Source: OSTI; NTIS; GPO Dep.

This paper contains four status reports on the following oil shale research projects: (1) Lawrence Livermore National Laboratory 4-tonne-per-day pilot plant; (2) chemistry and kinetics of New Albany shale flash pyrolysis under Hot-Recycled-Solid (HRS) conditions; (3) modeling of shale oil cracking and coking in the HRS process; and (4) modeling and analysis of particle slip and drag in a lift pipe of the retort for the HRS process. Each project report has been indexed separately for inclusion on the data base. (CK)

0405 Properties and Composition

Refer also to citation(s) 14101, 14138, 14139, 14149, 14151, 14153, 14166

14168 (DOE/MC/11076–2952) **Conversion characteristics of 10 selected oil shales.** Miknis, F.P. Western Research Inst., Laramie, WY (USA). Aug 1989. 59p. Sponsored by USDOE,

Washington, DC (USA). DOE Contract FC21-86MC11076. Order Number DE91002028. Source: OSTI; NTIS; GPO Dep.

The conversion behavior of 10 oil shale from seven foreign and three domestic deposits has been studied by combining solid- and liquid-state nuclear magnetic resonance (NMR) measurements with material balance Fischer assay conversion data. The extent of aromatization of aliphatic carbons was determined. Between zero and 42% of the raw shale aliphatic carbon formed aromatic carbon during Fischer assay. For three of the shales, there was more aromatic carbon in the residue after Fisher assay than in the raw shale. Between 10 and 20% of the raw shale aliphatic carbons ended up as aliphatic carbons on the spent shale. Good correlations were found between the raw shale aliphatic carbon and carbon in the oil and between the raw shale aromatic carbon and aromatic carbon on the spent shale. Simulated distillations and molecular weight determinations were performed on the shale oils. Greater than 50% of the oil consisted of the atmospheric and vacuum gas oil boiling fractions. 14 refs., 15 figs., 1 tab.

14169 (IMMR–89/201, pp. 68-78) **Properties of GPC [Gel Permeation Chromatography] separated maltene fractions derived from Utah and Athabasca bitumen.** Kotlyar, L.S. (National Research Council - Division of Chemistry, Ottawa, Ontario (Canada)); Montgomery, D.S.; Woods, J.R.; Sparks, B.D.; Ripmeester, J.A. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

This work deals with bitumens derived from two different types of oil sands: (1) Athabasca from the McMurray formation in Alberta, Canada and (2) from the Unita basin in the Green River formation, Utah, USA. Maltenes separated from these two bitumen were fractionated by Gel Permeation Chromatography (GPC) into fractions having number average molecular weights in the range from 289 to 5,831 for Athabasca and from 300 to 11,985 for Utah maltenes. The fractions obtained were examined by vapor pressure osmometry, absorption spectrometry in the visible region as well as proton and ^{13}C NMR. Utah fractions were more aliphatic with longer average aliphatic chain length. Branched and alicyclic types were more abundant in the Utah samples, especially those of low MW. There was an apparent difference in the hydrocarbon structure of both maltene GPC fractions at MW approximating 800. An abrupt change in the correlation between the light absorbing parameter K_{500}/K_{600} and molecular weight at MW approximating 800 was also observed. It is suggested that these rapid changes provide a convenient means of dividing the maltenes into two classes which may be used to characterize the maltenes of heavy oils and bitumens derived from various sources.

14170 (IMMR–89/201, pp. 98-103) **The chemical aspects of Alberta tar sand bitumens.** Strausz, O.P. (Univ. of Alberta, Edmonton (Canada)); Mojelsky, T.W.; Ignasiak, T.M.; Frakman, Z.; Payzant, J.D.; Lown, E.M. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Comparison of the molecular composition of the bulk material of the distillable portion of Athabasca tar sand maltene with the undistillable, heavier aromatic maltene and asphaltene portions leads to the conclusion that they have originated from different biotic source materials.

14171 (IMMR–89/201, pp. 112-118) **Relationship of chemical type composition with rheological properties of asphalts.** Poirier, M.A. (Esso Petroleum Canada, Sarnia, Ontario (Canada)); Sawatzky, H. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

This work deals with the study of asphalt and asphalt components derived from Cold Lake bitumen. A major aspect of this study was the separation of Cold lake asphalt into saturates, naphthene aromatics and propane precipitated asphalt. The latter is high in polar aromatics and asphaltenes. These separated fractions and petroleum was were blended in significant proportions with another asphalt and Cold Lake asphalt and the effects on the asphalts' rheological properties were determined. The low temperature properties were of special interest. In addition, the chemical type characterization was performed on processed Cold Lake residue, air blown asphalt and appropriate asphalts obtained from various conventional crudes. The Penetration Index (temperature susceptibility), Pen-Vis number, low temperature stiffness, ductility and glass transition temperature were investigated. The Penetration Index was shown to correlate with the asphaltene/wax + polar aromatic ratio. The saturates fraction in the only compound-type that increases the Pen-Vis number when blended into asphalt and this fraction also significantly reduces stiffness at –20°C. Both the low temperature stiffness and ductility are influenced by the Colloidal Instability Index (saturates + asphaltenes/naphthalene aromatics + polar aromatics). The glass transition temperature was found to correlate with the polar aromatics content.

14172 (IMMR–89/201, pp. 119-123) **Tar sands and their water content.** Audeh, C.A. (Mobil Research and Development Corporation, Princeton, NJ (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Although hot water flotation is commercially practiced, its applicability is restricted to tar sands in which the sand particles are separated from the bitumen by an envelope of water. Such sands are usually described as water wet. The author wanted to develop a technique by which he could determine if a tar sand is water wet and is thus amenable to the hot water flotation process. The author has found that only a fraction of the water content of a tar sand can be removed by treating a sample of tar sand with anhydrous methanol and by drying at room temperature under reduced pressure. Further, an additional amount of water is removed when the dried sample is subjected to the usual Dean and Stark entrainment distillation. This procedure identifies two types of water which are best described as extraneous and intrinsic and their sum is equal to the total water content of the tar sand as determined by entrainment distillation. The author believes that the extraneous water is located at the exterior surface of the bitumen and the intrinsic is not. Possible it forms a layer between the sand particles and their bitumen envelope. The author believes that the presence of the intrinsic water indicates that the tar sand is water wet and would be amenable to the hot water process. For a series of tar sand samples from Utah, he has found that the amount of extraneous water varies and that of the intrinsic is constant. Further, by heating the clay fines recovered from the bitumen-free sand to about 400°C, water of hydration was also identified.

14173 (IMMR–89/201, pp. 124-124b) **Definition and world resources of natural bitumen.** Meyer, R.R. (Department of the Interior, Reston, VA (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

The United Nations Information Centre for Heavy Crude and Tar Sands defines natural bitumen as a petroleum having a viscosity greater than 10,000 cp and defines crude oil as less viscous than 10,000 cp. Heavy crude oil has a density between 10° and 20° gravity API and extra-heavy oil a density below 10° gravity API. BP Exploration Company, however, has proposed that all hydrocarbons more viscous than 100 cp simply be termed heavy oil. For resource studies, a definition based on density is advantageous because, although viscosity data are rarely published, density data are readily available. Natural bitumen includes the material commonly termed tar sands, oil sands, or natural asphalt. It is here considered only as a source of synthetic fuels and not for limited use as road metal or mastic, its principal application in the past. The demonstrated resource of natural bitumen in place amounts to about 2,500 billion barrels, with an additional 865 billion barrels inferred. Presefit production for synthetic fuels amounts to 345,000 barrels per day, although an indeterminant additional amount is

mined for use as road material. Of the demonstrated resource in place, about 68% is found in North America, mostly in Alberta, Canada; 27% in the Soviet Union; 5% in Europe; and small amounts elsewhere. In the U.S., the resource in place in the ten largest deposits is estimated to total about 42 billion barrels and, in Canada, about 2,500 billion barrels. Using an assumed worldwide recovery factor of 15% of bitumen in place, both surface and in situ, for all technologies from all deposits, natural bitumen represents a petroleum recoverable resource of about 500 billion barrels.

14174 (IMMR–89/201, pp. 219-231) **Morphology of sulfide minerals in eastern oil shale.** Mason, G.M. (Univ. of Wyoming Research Corporation, Laramie (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

X-ray diffraction (XRD) and scanning electron microscopy/energy dispersive X-ray analysis (SEM/EDX) were used to investigate the mineralogy and crystalline morphology of sulfide minerals in Chattanooga Shale. Gravity concentration and digestion procedures were used to isolate the materials from samples of bulk shale. Iron disulfide mineral abundance averaged 7.6 wt %, with a range of 1 to 17 wt % for the entire section. Pyrite (isometric FeS_2) was the most abundant sulfide mineral identified, with all classic crystalline morphologies observed including pyritohedral, octahedral, and cubic, also, framboidal and pyrite replacement of organic matter, as well as nondistinct crystalline masses. Other sulfide minerals identified were marcasite (orthorhombic FeS_2), pyrrhotite (hexagonal $Fe_{1-x}S$), sphalerite (tetrahedral ZnS), and galena (isometric PbS). Sulfur-bearing alteration minerals identified were gypsum (monoclinic $CaSO_4 \cdot 2H_2O$) and copiapite (triclinic $Fe_{14}O_3(SO_4)_{18} \cdot 63H_2O$), which appeared as crystalline masses on the surfaces of sulfide minerals.

14175 (IMMR–89/201, pp. 269) **Development of a coking indicator for oil shales.** Miknis, F.P. (Univ. of Wyoming Research Corporation, Laramie (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

The conversion behavior of ten oil shales from seven foreign and three domestic deposits has been studied by combining solid- and liquid-state ^{13}C NMR measurements with material balance Fischer assay conversion data. The extent of aromatization of aliphatic carbons during Fischer assay was measured to determine whether this measurement could be used to define a coking indicator for oil shales. Preliminary results indicate that the greater the carbon aromaticity of the kerogen, the greater the conversion of aliphatic to aromatic carbon. It is suggested that the net increase in aromatic carbon during Fischer assay can be used to develop a quantifiable coking indicator for oil shales. Currently, the tendency to coke during Fischer assay is judged as slight, moderate, or heavy based on visual inspection of the spent shale. The combination of material balance Fischer assay data and NMR measurement represents a second-generation method for evaluating oil shale conversion and coking behavior.

14176 (IMMR–89/201, pp. 270-286) **Comparison of hydroretorting, Fischer assay and Rock-Eval analyses of some world oil shales.** Dyni, J.R. (Geological Survey, Denver Federal Center (CO)); Anders, D.E.; Rex, R.C. Jr. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

Samples of oil shale of varied origins and ages were collected from 32 deposits in 17 countries. The samples were analyzed by a hydroretorting assay (HRA) method and the results were compared to conventional Fischer assay (FA) and Rock-Eval analyses. The hydroretorting index, HRI, is defined as $(O_{HRA}/O_{FA}) \times 100$, where O_{HRA} is the quantity of oil determined by HRA and O_{FA} is the quantity of oil determined by FA. For 66 samples that produced 40 or more liters of oil per metric ton of rock by HRA, the HRI ranges from 86 to 460. The largest improvement in oil yields by HRA was found for thermally immature oil shales of marine origin with organic matter having relatively low hydrogen to carbon ratios. The HRI for 39 such samples (classified as marinites) range from 129 to 460 and average 228. Some of the best examples of this group include Devonian-Mississippian shales of eastern U.S. and Canada, shales of Pennsylvanian age of Indiana, Upper Cretaceous shales of Morocco and Jordan, and the Cambrian Alum Shale of Sweden. The Alum Shale is particularly noteworthy; the HRI for two samples is 302 and 460. On the other hand, the HRI for samples of lacustrine oil shales having relatively high hydrogen to carbon ratios (lamosites) show less improvement; 15 such samples have HRI numbers of 88 to 192 that average 139. The sum of the S1 and S2 values from the Rock-Eval analyses correlates quite well with oil determinations by FA, but less so with the oil determinations by HRA. The data suggest that the major source of oil from FA analysis appears to be from the fraction of organic matter containing dominant aliphatic carbon, whereas the additional oil generated by HRA analysis may be from that part of the organic matter with dominant aromatic carbon.

14177 (IMMR–89/201, pp. 519-530) **Characterization of liquid and gaseous products from the KENTORT II fluidized bed retort/gasifier.** Taulbee, D.N. (Univ. of Kentucky, Lexington (USA)); Carter, S.D. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

Analytical data for the liquid and gaseous products evolved during operation of the KENTORT II in the integrated retort/gasifier mode are presented. The reactor was operated in both a non-recycle mode, in which heat for pyrolysis was provided by the fluidizing media and an external coaxial furnace, and in a solids recycle mode where a portion of the pyrolysis heat was provided by hot gasified shale. Operation of this unit in the solids recycle versus non-recycle mode resulted in moderate declines in oil yield. This decline is explained as enhanced coking and cracking of product on the surface of the hot recycle solids as evidenced by preferential removal of aromatic liquid components and higher alkene/alkane ratios in the product gas. Further, it is shown that inverse variation of the temperature and rate of solids recycle to provide a constant proportion of heat for pyrolysis results in greater oil cracking losses when higher recycle temperatures are used relative to higher recycle rates. In general, the liquid product properties obtained from operation in the solids recycle mode were very similar to those from non-recycle mode operation with the exception of minor improvements in viscosity, average molecular weight, and H/C molar ratios.

14178 (IMMR–89/201, pp. 533-538) **Specific gravity-Fischer assay relationships among eastern oil shales.** Schultz, C.W. (Univ. of Alabama, Tuscaloosa (USA)); Bates, J.B. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

The specific gravities of raw oil shales and their beneficiation products were measured with a helium pycnometer. Measured specific gravities show a very high degree of correlation with the oil yield as measured by Fischer Assay and with the carbon content as determined with a LECO CHN analyzer. The correlations were sufficiently strong to permit the use of specific gravity measurements in the control of pilot plant operations and in the evaluation of laboratory tests. Specific gravity-oil yield relationships were developed for samples from Alabama, Indiana, Kentucky, Ohio, Michigan, and Tennessee.

14179 (IMMR–89/201, pp. 540) **Laboratory furnace design for programmed temperature pyrolysis of fossil fuels.** Foster, K.G. (Lawrence Livermore National Laboratory, CA (USA)); Frohwien, E.J.; Taylor, R.W.; Bowen, D.W. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

For the last several years at Lawrence Livermore National Laboratory, the authors have been looking for a laboratory furnace for programmed-temperature pyrolysis of fossil fuels. Not completely satisfied with those found in the commercial market, they have taken many ideas and requirements to develop a furnace for laboratory use. The furnace must have the following features: (1) It must be reliable and safe to use. (2) It must have insulation which gives a good linear temperature profile (uniform vertical heating) and quick cool down. It also has to be asbestos-free. (3) It must be able to be mounted both horizontally and vertically. (4) It must have modest energy requirements so that it can be used with various controllers. The authors developed a vermiculite-insulated tube furnace heated by helically wound resistance wire positioned within helical grooves on the surface of a ceramic cylinder. This in turn surrounds a double slotted stainless steel cylindrical liner. For uniform heating, the pitch of the helix is shorter over the two end portions of the ceramic cylinder. The furnace can be designed to accommodate either large- or small-diameter reactors. It provides uniform temperature, offers an extremely precise programmed heating capability, features rapid cool-down, and has modest power requirements. Now in the final stages of development, the prototype meets the criteria above. The authors are obtaining uniform temperature profiles and believe it is a good design.

14180 (IMMR–89/201, pp. 542) **Microscopic techniques for identification of coke.** Munoz, V.A. (CANMET, Devon, Alberta (Canada)); Mikula, R.J.; Lam, W.W. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

In the production of synthetic crude oil from oil sands, bitumen and heavy oils, the goal is to maximize production of liquid fuels and to minimize production of carbonaceous solids and gases. Coke formation is an undesirable result of catalytic cracking. Aside from reducing potential liquid yields, the deposition of coke can produce problems such as fouling of catalysts and a decrease in the heat transfer capacity of reactors, possibly leading to complete failure of the conversion system. The identification of coke, organic and inorganic solids suspended in process streams is therefore of importance as a monitoring tool. Electron microscopy is used mainly for the characterization of mineral components. The unequivocal determination of organic phases such as cokes, semicokes and heavy oils is achieved by optical microscopy using both white and blue light. The fluorescence characteristics in certain organic components allows their discrimination from coke and inorganic solids, which do not exhibit fluorescence under blue light. In turn, coke particles can be distinguished from inorganic solids using polarized and cross-polarized light, and by other optical parameters such as reflectance, color, isotropy or anisotropy.

14181 (IMMR–89/201, pp. 543) **Application of synchrotron radiation for analysis of oil shale and shale derived products.** Sundaram, M.S. (Brookhaven National Laboratory, Upton, NY (USA)); Shadle, L.J. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Exended x-ray absorption fine structure (EXAFS) spectroscopy, in combination with x-ray absorption near edge structure (XANES) analysis, is an advanced analytical technique for investigation of the molecular structure of the materials and is ideally suitable for studying the oil shale chemistry. Some advantages of EXAFS are that it is (1) atom specific, (2) insensitive to long-range disorder and (3) a bulk technique. From XANES, one can obtain the electronic oxidation state of the absorber and detect mixed valence states. By comparison with standards and via computer simulation and curve-fitting techniques, one can determine the actual bond length, type and number of neighboring atoms and other important data. A Kentucky oil shale and its pyrolysis products, which included the spent shale, heavy oil and light oil fractions, were analyzed at beam line X-19A at the National Synchrotron Light Source (NSLS). In order to compare the absorption features of various iron compounds in these samples, iron K-edge XANES/EXAFS spectra were recorded in the fluorescence mode. The iron K-edge spectra of the oil fractions were similar to each other and the spent shale contained much larger quantities of iron bearing components. The oxidation state of iron in the spent shale was characteristically different from that of the oil products. Furthermore, an independent synchrotron-radiation induced x-ray emission (SRIXE) analysis of the products showed the light oil fraction to contain significant quantities of As, Ni and Fe compounds. The trace element distribution in the spent shale was similar to that of the original shale and certain elements such as Ti, Mn, Cu and Zn tend to concentrate on the spent shale. The implications of these findings on oil shale processing will be presented.

0407 Health and Safety

Refer also to citation(s) 14192

0408 Economic, Industrial, and Business Aspects

Refer also to citation(s) 14144

14182 (IMMR–89/201, pp. 79-85) **Asphalt from Utah Tar Sands - a JWBA [James W. Bunger and Associates] project sponsored by the U.S. Department of Energy.** Bunger, J.W. (James W. Bunger and Associates, Inc., Salt Lake City, UT (USA)); Wiser, J.W.; Russell, C.P.; Devineni, P.A.V. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

JWBA [James W. Bunger and Associates] has initiated a project for development of Utah's tar sands for production of specification-grade asphalt. Projected prices and costs strongly indicate economic viability within the market limitations. JWBA has licensed the water extraction technology developed at the University of Utah and has received both Phase-I and Phase-II funding from the U.S. Department of Energy SBIR program for development of the technology and project. The project calls for technology R&D, resource evaluation, market and transportation assessment, engineering and project optimization. Private funding will be used for commercial development activities related to resource acquisition, patent and market development and permitting. A 100 lb/hr process development unit (PDU) has been designed and construction is 50% complete. The PDU consists of three principal modules: extraction cleaning and distillation. Start-up is anticipated for January, 1990. All of the major candidate deposits will be considered. The project will develop the engineering data, resource data and commercial information required for a major investment.

14183 (IMMR–89/201, pp. 431-439) **Beginning of an oil shale industry in Australia.** Wright, B.C. (Southern Pacific Petroleum N.L. & Central Pacific Minerals N.L. Sydney (Australia)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

The Tertiary oil shale deposits of Queensland Australia contain some 27 billion barrels of insitu shale oil. The Stuart Oil Shale Deposit located near Gladstone (500 km north of Brisbane) contains rich, readily accessible oil shale. The Kerosene Creek Member of the deposit presents an opportunity for selective mining of high grade oil shale (170 liters/ton). Southern Pacific Petroleum and Central Pacific Minerals (The Companies) have completed preliminary engineering design using Canadian based retorting technology and convention-commercial plant to be built 15 km north of Gladstone. The existence of infrastructure including power, water, port facilities and labor creates the most economically attractive oil shale resource in the world. The objective of the initial plant is to provide the basis for a full scale oil shale industry in Australia and thus support the aim of the Australian Government to maximize energy self sufficiency and minimize balance of payments debts as we enter the 21st century.

14184 (IMMR–89/201, pp. 440-446) **Niche market assessment for eastern oil shale.** Sinor, J.E. (J.E. Sinor Consultants

Inc., Niwot, CO (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

In an era of low oil prices, synthetic fuel projects cannot be economically justified. However, it is extremely desirable that research and development of synthetic fuels continue, so that improved technology will be available at the time synthetic fuels become necessary. Financing of such research and development is difficult. This paper examines the question of whether nonfuel products from oil shale could be profitable enough that a small-scale oil shale facility could stand on its own. This would make it possible to maintain an ongoing oil shale development effort at a large enough scale to make significant technical progress. A major problem in considering nonfuel markets for oil shale products is finding a market large enough to accept all of the output from even a small-sized oil shale facility. Price-volume relationships for chemical products were examined. It was concluded that the target market slate should be no more than two or three products. Products which might fall in the desired price-volume range are discussed.

0409 Waste Management

Refer also to citation(s) 14149, 14162, 14195

14185 (IMMR–89/201, pp. 339-347) **The use of activated carbon in the treatment of a synthetic oil shale processing wastewater.** Ballard, R.W. (Tennessee Technological Univ., Cookeville (USA)); Bonner, W.P.; Bustamante, R.; Prabhu, S.V. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

Results from batch carbon adsorption experiments are reported that determined removal of four selected contaminants from a synthetic wastewater for a pressurized, fluidized-bed hydroretorting oil shale process. Acetone and thiocyanate exhibited very low affinities for activated carbon, while larger quantities of pyrrole and propionitrile were removed. All four compounds, however, demonstrated low adsorbances relative to other organic species that are successfully removed from solution by activated carbon. The presence of other compounds in multiple solute experiments had little effect on the adsorption of acetone due to its low affinity for activated carbon. The adsorption of pyrrole in multiple solute experiments was consistently less than that in single solute experiments due to competition for active sites in multiple solute experiments. Propionitrile and thiocyanate, on the other hand, demonstrated a decrease in adsorption in the presence of multiple solutes except at very low concentrations. All data were reasonable fitted with the Freundlich isotherm.

14186 (IMMR–89/201, pp. 348-359) **Biological treatability of selected organic components of an oil shale processing wastewater.** Miles, S. (Tennessee Technological Univ., Cookeville (USA)); Bustamante, R.; Bonner, W.P. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

Biological treatability experiments are reported for the synthetic waste of a pressurized, fluidized-bed hydroretorting oil shale process. Batch activated sludge experiments indicate that acetone, propionitrile, pyrrole, and thiocyanate are biodegradable. Chemical oxygen demand (COD) values were reduced to minimum values of 20 to 40 mg/l in batch tests, and specific substrate concentrations were reduced to nondetectable levels in multiple substrate experiments. In double substrate combinations involving acetone, propionitrile, and pyrrole, contaminants were metabolized simultaneously. Lag phases were present in all experiments involving the thiocyanate species, but it appears that the lag phase may be eliminated in continuous flow studies, which have been initiated and will involve all four substrates.

14187 (IMMR–89/201, pp. 360-364) **Kinetics of selected heavy metal dissolution from shale.** Robertson, E.A. III (Univ. of Michigan, Ann Arbor (USA)); Fogler, H.S.; Gyenese, J.J. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

In order to efficiently reduce the level of heavy metals in oil shale by dissolution, knowledge of the dissolution rates is essential. Reducing the levels of these metals reduces the environmental impact of the disposal. In these studies, the authors have examined the rates of the dissolution of barium, cadmium and iron from retorted Indiana New Albany shale using hydrochloric and nitric acids as solvents. The kinetics of these reactions is complicated by parallel reactions where the heavy metal ion is present as several different salts, each with its own dissolution kinetics. The most effective first approach to describing the shale system is to use a power law model of the dissolution of the metal species from all possible sources, in effect an average dissolution rate. Some of the kinetic parameters of this system are examined and possible ways of taking advantage of this situation are discussed. Furthermore, it has been observed that the addition of sodium chloride to aqueous hydrochloric acid enhances the dissolution of barium from retorted shale by a factor of roughly 8 over the rate in aqueous hydrochloric acid.

14188 (IMMR–89/201, pp. 365-369) **Evaluation of oil shale solid waste for soil stabilization.** Turner, J.P. (Univ. of Wyoming, Laramie (USA)); Suryavanshi, K.J. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

Cementitious oil shale solid wastes are evaluated for potential use as soil stabilizers. A testing program is described which consisted of index tests, compaction properties, and unconfined compressive strength of several mixtures, of spent shale and soil. Two types of soil are evaluated for possible spent shale stabilization, a sand with nonplastic fines and a highly plastic clay. Three types of eastern spent shale and one western spent shale are evaluated for stabilizing potential. The results of the testing program are presented and show that, based on unconfined compressive strength, soil stabilization using spent oil shale is technically feasible and may be a cost-effective method for improving the engineering properties of highway pavement subgrades.

14189 (IMMR–89/201, pp. 458-464) **Application of LO-CAT chelated iron scrubbers to retort gases.** Chapman, D. (ARI Technologies, Inc., Palantine, IL (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings*. 548p. Source: OSTI; NTIS.

The production of oil shale presents some challenging technical problems. One such requirement involved with production of oil from Eastern or Western Shale is that of removing the sulfur-containing gases from the retort effluent with the minimum of cost and by-product pollutant production. The LO-CAT Hydrogen Sulfide Oxidation Process is an ideal approach to the desulfurization of the gases from both large scale in-situ retorts and batch or continuous retorting process. This process has been demonstrated on a commercial Western Oil Shale in-situ retorting operation. It has also been licensed for use in sixty other process applications, and over thirty LO-CAT units are in current operation. The process removes hydrogen sulfide selectively from gas streams and converts it directly to elemental sulfur by use of chemically solubilized iron. This paper reviews the basic chemistry and configuration of LO-CAT units, and describes the past and future applications of the process to several shale oil production scenarios.

14190 (IMMR–89/201, pp. 465-470) **Removal of hydrogen sulfide by combusted Rundle oil shale: Sulfidation of iron oxides.** Killingley, J.S. (CSIRO Division of Fuel Technology, Menai (Australia)); Callaghan, D.G.; Day, S.J. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY

(USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Oil shale from the Rundle deposit of Queensland, Australia, after retorting and combustion in air, contains hematite and magnetite. Studies of the reactions of hydrogen sulfide with this combusted shale, and with the individual iron oxides, showed the sulfidation kinetics to be first order with respect to hydrogen sulfide with activation energies of 35±1, 59±3, 66±2 kJ mol^{-1} respectively for hematite, magnetite and combusted shale. Under dry conditions the shale trapped 36 mg of hydrogen sulfide per gram of combusted shale. With steam present, the iron oxides did not trap hydrogen sulfide and the combusted shale was also ineffective because, apart from negligible sulfidation of its iron oxide minerals, another sulfur-trapping mineral, calcium oxide, had effectively been removed by silication during combustion. The potential to control hydrogen sulfide (produced during steam retorting of shale) by recycled combusted Rundle shale is therefore poor, but a characteristic of this shale during pyrolysis is that most hydrogen sulfide is released above 500°C, so that by minimizing retort temperatures, consistent with appropriate oil recovery, substantial control of hydrogen sulfide should be possible.

0410 Environmental Aspects

Refer also to citation(s) 14144

14191 (IMMR–89/201, pp. 326-338) **Chemical equilibria model analysis of Hope Creek eastern oil shale lysimeter leachate data.** Essington, M.E. (Univ. of Wyoming Research Corporation, Laramie (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Leachates from field lysimeters containing an eastern oil shale, a retorted eastern oil shale, and an oil shale fines/retorted oil shale mixture were subjected to chemical equilibria model analysis by the GEOCHEM model. Results of the chemical equilibria model analysis provided a more detailed characterization of the chemistry of oil shale materials. The aqueous chemistry of the lysimeter leachates is dominated by free ionic metal species and metal sulfate ion pairs. Activity diagrams show that free metal ion activities (with the exception of Ca^{2+}) are directly related to SO^{2-}_4 activities. This suggests that the aqueous activities of the metals examined are not supported by metal sulfate solid phases. However, an examination of metal sulfate ion activity products (IAPs) as a function of time show that the IAPs approach constant values after approximately 800 days of the field study. For the great majority of the metals examined, the IAP values suggest leachate undersaturation with respect to even the most stable metal sulfate phases. Leachates from all three materials are predicted by GEOCHEM to approach equilibrium with respect to gypsum ($CaSO_4 \cdot 2H_2O$) and goethite (FeOOH). In addition equilibrium with respect to melanterite ($FeSO_4 \cdot 7H_2O$), Fe-jurbanite ($FeSO_4OH$), and franlinite ($ZnFe_2O_4$). Aluminum activities in all three lysimeter leachates fall within the stability region of several basic aluminum sulfates. However, Al^{3+} activities in the lysimeter leachates are not supported by sulfate phases.

14192 (IMMR–89/201, pp. 370-385) **Environmental and health surveillance monitoring results at Parachute Creek Shale Oil Project, 1988 and 1989.** Benton, J.B. (Office of Synthetic Fuels Projects, Washington, DC (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

The Parachute Creek Shale Oil Project is one of four synthetic fuels facilities awarded financial assistance under the Energy Security Act of 1980. The Project agreed to develop and implement an Environmental Monitoring Plan (EMP) that incorporates both permit-mandated monitoring and supplemental monitoring in the areas of water, air, solid waste and health surveillance. During 1988, the Project completed the first tier of supplemental sampling and the second year of health surveillance. The concomitant completion of sample analysis, data management and reporting, and quality assurance/quality control efforts met all the EMP implementation requirements. The data presented in the Annual Health Surveillance Report ant the Tier I Supplemental Monitoring Report and discussed. along with modifications for future sampling and analysis.

14193 (IMMR–89/201, pp. 386-394) **Simulated climate and shale pile response within a large scale environmental chamber developed in Wyoming.** Skinner, Q.D. (Univ. of Wyoming, Laramie (USA)); Reeves, T.L.; Turner, J.R.; Hasfurther, V. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

The University of Wyoming, College of Agriculture, and Department of Energy have developed an environmental chamber covering two lysimeters 10 feet wide, 10 feet deep, and 24 feet wide. This facility was designed to simulate temperatures from –20 to 120 degrees Fahrenheit, 10 to 100 percent relative humidity, rain from 0 to 5 inches per hour, and light of up to 4,800 candles at the surface of filled lysimeters. This facility is now being used to quantify amount of water entering combusted shale embankments, how it moves within this shale material, and finally how embankment strength is altered. Tracking water movement into and within shale material is being accomplished by simulating the climate over exposed lysimeters filled with like shale materials in western Colorado. The purpose of this paper will be to: (1) describe the Wyoming facility and why it was constructed, and (2) report how accurately this environmental structure simulates actual field temperature and relative humidity collected a year earlier in Colorado.

14194 (IMMR–89/201, pp. 394-401) **Rainfall simulation and hydrologic monitoring of a combusted western oil shale in large scale lysimeters.** Reeves, T.L. (Univ. of Wyoming, Laramie (USA)). Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. 1989. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

A research program has been developed at the University of Wyoming to physically model (produce) climatic and hydrologic processes and study hydrologic, geotechnical, and geochemical factors affecting the behavior of large scale oil shale waste embankments. Physical data produced will be used to evaluate computer generated data in an evaluation of model performances. To accomplish these tasks, large scale lysimeters filled with processed oil shale have been established at a field site in the Piceance Basin, Colorado, and within a large scale environmental laboratory at the University of Wyoming. The operation and climatic control of this laboratory, called the Watershed, Climate, and Hydrology Simulation Laboratory (WCHS), is briefly described. The purpose of this paper is to specifically describe the rainfall simulation system used within the WCHS Lab and to show preliminary results of resultant moisture flux in the disposed processed oil shale.

0440 Combustion

14195 (DOE/MC/27084–2960) **Fluidized bed combustor test report for Proof-of-Concept Oil Shale Facility, Colorado Tract C-b.** Moore, R.E.; Vawter, R.G.; Yerushalmi, J. Occidental Oil Shale, Inc., Steamboat Springs, CO (USA). Nov 1990. 123p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC21-90MC27084. Order Number DE91002038. Source: OSTI; NTIS; GPO Dep.

During 1990 Occidental Oil Shale, Inc. prepared a Plan and Justification for the Department of Energy for a Proof-of-Concept Oil Shale Facility on Colorado Tract C-b. The subject facility is designed to produce shale oil from the Modified Insitu (MIS) process and electric power from the burning of indigenous fuels. One of the tasks included in the program is Fluidized Bed Combustor Design Parameter Confirmation. This report summarizes the work conducted for that task. Two pilot plant tests were conducted on a combination of oil shale, simulated gas from the MIS process and coal; at facilities owned and operated by manufacturers of circulating fluidized bed combustors (CFBC). In addition air emission testing was conducted during the two pilot plant tests and on the

residue ash produced from the pilot plants. Based on the results of the tests, it has been concluded that combinations of oil shale, coal and MIS gas can be efficiently combusted in a demonstration scale CFBC in an environmentally acceptable manner. The tests also confirmed that Western US oil shale is a very effective SO_2 removal agent. Three appendices contain the reports provided by the contractors that conducted the principal tests. These reports were processed separately for inclusion on the data base.

05 NUCLEAR FUELS

Refer also to citation(s) 14499

0501 Reserves, Exploration, and Mining

Refer also to citation(s) 14236, 14281, 14322, 14323, 14325

14196 (INIS-mf–12807) **Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.** Talbot, K.H.; Lakshmanan, V.I. (eds.). Canadian Nuclear Society, Toronto, ON (Canada). 1988 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

The first Canadian Nuclear Society 'Uranium and Electricity' Conference provided a forum for discussion on developments in all phases of the nuclear/electricity fuel cycle. It included both technical and management aspects in areas of mutual interest to those involved in mining, refining, fuel manufacture, reactor operation and irradiated fuel. The 60 papers offered in this volume present detailed discussions on uranium exploration and mining; waste management; uranium metallurgy, refining and byproducts; irradiated fuel management; effluent management, uranium chemistry, refining and the environment; environmental protection from low level waste; fuel design, manufacture and performance; regulation and control of radiological hazards; Canadian power reactor fuel and safety trends; and future developments.

14197 (INIS-mf–12807, pp. 1.1-1.7) **Underground mining in vein and layer deposits: New methods for concentrating mining works, increasing outputs and reducing ore dilution.** Marino, J.M. (Compagnie Generale des Matieres Nucleaires (COGEMA), 92 - Chatillon (France)); Fontaine, R. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

COGEMA applies, in underground operations, working systems adapted to the shape of the ore bodies, as illustrated by two methods recently developed in France. (1) ECARPIERE mine stopes a vertical vein simultaneously using cut and fill for the upper part and undercut and fill with cemented backfilling for the lower part. This method allows the concentration of several working faces in a limited area and consequently the concentration of equipment, power distribution, backfilling means, primary ventilation, supervision and maintenance. The resulting output was significantly increased. (2) LODEVE mine operates a short wall method for mining thin layers; ore is mined according to the mineralization limits, waste is blasted at the footwall and used as part og the integral backfilling. The method improves profitability of thin mineralizations in the general frame of a complex carbonate leach ore processing where dilution must be drastically reduced.

14198 (INIS-mf–12807, pp. 1.17-1.20) **Low grade uranium deposits being exploited in China.** Wang Jian (China Uranium Mining and Metallurgy Society (People's Republic of China)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Known uranium deposits in China are mainly of granitic, volcanic and sedimentary types. A lot of ore deposits are low in grade and small in size. How to extract these resources at a profit has been a challenge to natural uranium producers. If the production cost of natural uranium from these low grade deposits is higher than the current long-term contract price in the international market, plenty of resources will be lying idle underground for a long time. The Chinese government's self-reliance policy that the nuclear fuel of reactors will be mainly supplied from domestic natural uranium products can not be executed completely. Research works and pilot tests have been done and technical improvements have been carried out with the aim of making the low grade deposits being extracted at an appropriate profit. Effective measures have been taken by some uranium mines to reduce production costs. Measures taken include improving mining methods, utilizing radiometric sorting techniques, extracting uranium from mine water, recovering uranium by solution mining and recovering associated useful minerals or compounds from ores. At present, some low grade uranium deposits are being exploited at proper costs. This paper gives a brief description of the improved techniques practiced and parameters achieved.

14199 (INIS-mf–12807, pp. 1.21-1.30) **Eagle Point: discovery, definition and development.** Fountain, D.K. (Eldorado Nuclear Ltd., Ottawa, ON (Canada)); Van Huyssteen, E.; Homeniuk, L.A.; Andrade, N.; Ward, D.M.; Clark, G.W. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

The combined Eagle Point uranium deposits are currently the third largest in Saskatchewan, after the Cigar Lake and Key Lake deposits. Several features of the Eagle Point deposits make them attractive from their mining and metallurgical perspectives, such as their steeply dipping tabular vein morphology, the competence of the host rocks due to a lack of intense alteration, and their simple mineralogy. Since the discovery and definition of the deposits, development has been planned to proceed in three phases: (1) detailed engineering feasibility studies and metallurgical test work; (2) underground test mining and ore reserve confirmation; and (3) production mining. This paper reviews the various aspects of the discovery, definition, and development of the Eagle Point deposits.

14200 (INIS-mf–12807, pp. 1.31-1.39) **An update on bacterial leaching of uranium at Denison Mines.** Marchbank, A. (Denison Mines Ltd., Elliot Lake, ON (Canada)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

In 1982 Denison Mines formed a task force to investigate the feasibility of developing a bacterially-assisted leaching technique to be used as a primary ore extraction method. In 1984 an agreement with the federal government provided financial assistance to allow Denison to carry out a full-scale production demonstration of the technology with the cooperation of CANMET. The modified flood leaching technique is used after conventional mining is completed in an area and all the ore has been removed. The low-grade ore band above the existing stope is taken down with a single blast, the stope sealed off with concrete bulkheads, and the block is flooded and drained. During the three-week rest periods the bacteria oxidize the pyrite and create an excellent environment for uranium dissolution. The block is then flooded and drained to remove the dissolved uranium and introduce fresh bacteria. Special aeration and exhaust facilities are needed to supply the bacteria with oxygen and carbon dioxide and to cope with the high levels of radon gas produced by the newly-liberated uranium. On-site research is concentrating on large-scale laboratory testwork and production monitoring. Approximately 90 flood leaching stopes are in operation. In 1987 over 840,000 lbs of uranium came from bacterial leaching at the Elliot Lake mine.

14201 (INIS-mf–12807, pp. 1.9-1.16) **Design considerations at the Cigar Lake project.** Peebles, G.A. (Cigar Lake Mining Corporation, SK (Canada)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

The Cigar Lake uranium deposit in northern Saskatchewan is the largest high grade uranium deposit in the world with a total reserve of 385 million pounds U_3O_8. The main section of the deposit has a total geological reserve of 285 million pounds at an average grade of 14% U_3O_8. Cigar Lake Mining Corporation (CLMC) which is developing this deposit is a wholly owned operating company established by the joint venture owners, Saskatchewan Mining Development Corporation, Cogema Canada Ltd., Idemitsu Uranium Exploration Canada ltd., Corona Grande Exploration Corporation, and Korea Electric Power Corporation. CLMC has recently commenced an underground evaluation of the deposit. This program which is expected to take about 2 1/2 years to complete involves sinking a 500 metre deep shaft, and drifting out to the ore zone on two levels. Once the orebody is reached trial mining methods will be carried out to demonstrate the technical feasibility of mining the deposit. Following completion of the Test Mine and the feasibility study in 1990 the owners will be in a position to take a final decision on development and production influenced by market conditions at the time. This paper describes the geological characteristics of the deposit and the development of the test mining program.

14202 (INIS-mf–12807, pp. 6.7-6.11) **Technical co-operation in the nuclear fuel cycle by the International Atomic Energy Agency.** Smith, A.Y. (International Atomic Energy Agency, Vienna (Austria). Div. of Nuclear Fuel Cycle and Waste Management); Tauchid, M.; Ajuria, S.; Noe, M. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

At the request of its developing country Member States the IAEA provides technical co-operation in various areas of the nuclear fuel cycle. Most technical co-operation has been in the fields of uranium exploration and development. In recent years, however, there has been an increase in requests for assistance in nuclear fuel fabrication and the evaluation of fuel performance. In 1988 the Agency is carrying out 44 technical co-operation projects related to the nuclear fuel cycle in 34 countries. Technical assistance has been of two kinds: projects funded under the United Nations Development Programme, and projects funded under the Agency's Regular Programme of Technical Co-operation. In the field of uranium, projects have included activities in uranium geology, exploration techniques, laboratory analysis, ore reserve estimation, mineral resource evaluation, mining and extraction, and university teaching in these fields. The present paper outlines the types of Agency technical co-operation and presents data on the regional distribution of projects. The nature and costs of these projects are discussed along with the mechanisms employed in their implementation in institution building and technology transfer. The ultimate objective of the Agency's programme is the transfer of technological knowledge with the aim of giving Member States better understanding and control of their own resources.

14203 (INIS-mf–12807, pp. 7.22-7.31) **An overview of Saskatchewan's program for the environmental regulation of uranium mining.** Barsi, R.G. (Saskatchewan Environment and Public Safety, Prince Albert (Canada). Mines Pollution Control Branch). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Since milling of uranium ores began in Saskatchewan in 1953, in excess of 20 million tonnes of tailings have been produced, and in excess of 16 million tonnes of these remain on surface. The technology and operating methods for the waste management systems has improved greatly in the intervening period and a high level of performance is expected from both existing and proposed operations. Regulatory experience indicates that existing operations are consistently meeting environmental objectives. Technological and operational improvements for the purpose of environmental protection are expected as additional experience is obtained. While the production potential for the future looks very promising, the high grade prospects will pose their own unique problems. In order to ensure that a high level of environmental protection is maintained within the uranium industry, it is essential that a firm and co-operative regulatory approach be conducted in conjunction with industry initiative and innovation.

14204 (INIS-mf–12807, pp. 7.32-7.35) **A conceptual decommissioning plan for a high grade uranium mine.** Meadley, T. (Amok Ltd., Saskatoon, SK (Canada)); Barbour, S.L.; Meneley, W.A. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

At the completion of the milling operations at Cluff Lake, the tailings management area will contain mill tailings that have typical Ra-226 concentrations of 17 Bq/g and in some areas concentrations as high as 274 Bq/g. A conceptual decommissioning plan has been developed for this area that will maintain radium concentrations in the adjacent lake to levels that are less than the surface water quality objectives set by the provincial government. A computer model based on field observations and laboratory experiments has been used to demonstrate the viability of the plan.

14205 (INIS-mf–12807, pp. 9.10-9.12) **The work of the joint panel on occupational and environmental research for uranium production in Canada.** Brown, L.D. (Saskatchewan Human Resources, Regina (Canada). Labour and Employment, Radiation Safety Unit); Tervo, R. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

The Joint Panel, as it is generally known, is a unique organization which provides a common forum for discussions between uranium producers, federal and provincial agencies, labour and others concerned with research related to uranium mining in Canada. The Panel was established in 1977 and has met bi-annually since that time to review current research programs and to discuss areas in which additional research appears to be necessary. The Joint Panel Annual Report has proved to be a valuable and keenly sought after reference document.

14206 (INIS-mf–12807, pp. 9.6-9.9) **Radiation risks in Saskatchewan uranium mines.** Brown, L.D. (Saskatchewan Human Resources, Regina (Canada). Labour and Employment); Webster, S.T. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Saskatchewan is the first jurisdiction in Canada that requires the accumulated risk from all types of radiation exposures to be less than the risk associated with a dose equivalence of 50 mSv. Compliance with this requirement is determined by applying the formula $E_1/P_1 + E_2/P_2 + ... + E_x/P_x < 1$ where E represents actual exposures from each form of ionizing radiation and P symbolizes the maximum permissible dose from that form of radiation.

0504 Feed Processing

Refer also to citation(s) 14196, 14321, 14337, 14338

14207 (INIS-mf–12807, pp. 3.16-3.23) **Solvent degradation and high sulphuric acid stripping in the Rabbit Lake uranium mill.** Decesare, J.M. (Eldorado Nuclear Ltd., Ottawa, ON (Canada)); Garratt, D.G.; Oliver, A.J.; Edwards, C.R. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

The Rabbit Lake uranium mill started processing Collins Bay B-Zone ore in 1985 using the conventional process of acid leaching/tertiary amine extraction followed by a new stripping method employing 400 g/L sulphuric acid as the stripping agent. By mid-1986 a large portion of the tertiary amine component of the solvent had degraded, producing a waxy gel which resulted in numerous operational problems and eventually required replacement of the solvent inventory. This paper describes several aspects of this problem including: (i) plant experience; (ii) identification of the degradation products as secondary amines complexed with sulphuric acid as both cationic and anionic complexes; and (iii) testwork directed at the resolution of the solvent degradation problem. This latter program identified the key operational parameters which must be controlled to prevent a recurrence of the problem, thereby allowing for routine use of the high acid stripping process.

14208 (INIS-mf–12807, pp. 3.12-3.15) **Strong acid stripping of tertiary amine for uranium recovery.** Swider, R.C. (Consulting Chemical and Metallurgical Engineering Services, Toronto, ON (Canada)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

A solvent extraction process utilizing 400 g/L H_2SO_4 for stripping uranium from tertiary amine solvent has been developed for use at the Rabbit Lake mill. The strong acid strip process is made effective by selecting favourable conditions for the sulphuric acid-uranium-tertiary amine equilibrium. Strip solution containing up to 125 g/L U_3O_8 is obtained. This new process was developed to ensure that the effluents met environmental objectives, and to permit the continued use of the existing solvent extraction circuit for uranium recovery from a new ore body, the Collins Bay B-Zone deposit. The process provided substantial technical advantages over other stripping alternatives and substantial economic advantage over the LAMIX ion exchange process. Plant operations have confirmed initial mini-pilot plant and large scale pilot plant operations. Overall results are better than the design standards for the process. Current operations and possible future improvements are reviewed.

14209 (INIS-mf–12807, pp. 3.24-3.31) **Uranium recovery and recycling within Eldorado.** Tomlinson, I. (Eldorado Nuclear Ltd., Ottawa, ON (Canada)); Burgess, D. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes the successful recovery of uranium from 'scrap' materials generated at the Fuel Services Division of Eldorado Resources Ltd., Port Hope, Ontario. The production of UF_6 and UO_2 in Port Hope generates a number of scrap products that cannot be recycled directly to the conversion facilities due to high concentrations of impurities, unacceptable physical properties and potential corrosion problems. This has resulted in the storage of these materials in drums at the operating site until a recycle route is established. Eldorado commenced a program in recent years to use the scrap materials within the company. This paper describes the program, the laboratory and process development and the implementation of the recycle processes using two successful examples. These are: (i) the recycling of a potassium diuranate (KDU) scrap in the closed Port Hope UO_3 plant, (which was specifically modified for this task), and (ii) the recycling of a uranium fluoride ash (filter ash) into the Rabbit Lake mill process.

14210 (INIS-mf–12807, pp. 3.2-3.11) **Pilot testing vat/heap leaching technology of uraniferous cobble ore at Key Lake.** Holl, N. (Key Lake Mining Corp., Saskatoon, SK (Canada)); Rosner, B. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Key Lake Mining Corporation extracts uranium ore from two orebodies at its site at Key Lake in Northern Saskatchewan. In addition, ore in overburden above the Gaertner orebody was present in till and esker material containing ore clasts with diameters from a few millimetres to approximately one meter. Close to 800,000 tonnes of this so called cobble ore with an average grade of 0.5% has been mined and stored separately from the direct mill feed ore. Satisfactory results from heap leach bench scale and 100 tonne column tests led to the subject of this paper, a 10,000 tonne vat-leach pilot test.

14211 (INIS-mf–12807, pp. 3.32-3.37) **Alternatives in uranium extraction processes.** Edwards, C.R. (Kilborn (Saskatchewan) Ltd., Saskatoon, SK (Canada)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Since the first commercial extraction of uranium in the early 1940's, the range of available process alternatives has greatly increased. This paper reviews techniques now in use, and discusses processes under development to reduce extraction cost, improve efficiencies, and ameliorate environmental impacts.

14212 (INIS-mf–12807, pp. 5.6-5.11) **Zero exchange of liquid effluents in acid uranium ore treatment: Process development and industrial experience.** Stergarsek, A. (Institut Jozef Stefan, Ljubljana (Yugoslavia)); Dolenc, F. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Conventional acid uranium ore treatment process has been modified by introduction of total recycling of liquid effluents, enabled by effective raffinate treatment process. Dry waste disposal was employed. Flowsheet and material balance of the process are given. The effectiveness of new system after 4 years industrial use was controlled and compared with pilot plant data. Environmental impact is given and shows minimal influence of mill operation on the chemical composition of surface waters. It is considered that the process may be successfully retrofitted in existing operations.

14213 (INIS-mf–12807, pp. 6.12-6.20) **A review of CANMET's acid chloride leaching of uranium ores.** Haque, K.E. (Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Conventional sulphuric acid leach processing of uranium ore is technically and economically viable but presents some environmental concerns because almost all of the radium and the sulphides, especially pyrite (an acid generating mineral), present in the ore report to the tailing disposal sites. In order to obtain leach tailings with a radium (226) content of 20-25 pCi/g solids and essentially free of pyrite, an alternative HCl leach process has been developed. Hydrochloric acid leaching of low-grade pyritic uranium ore (e.g. Elliot Lake U-ore) followed by flotation for pyrite removal from the final leach residue yielded tailings essentially free of pyrite and radionuclides, the radium level in the tailings being in the range of 25-30 pCi g^{-1} solids. Acid chloride leaching of Midwest Lake uranium ore, under various conditions (e.g., HCl, HCl-$CaCl_2$-O_2

pressure, HCL-$FeCl_3$) provided high extraction of U, Ni, As and Ra and tailings with radium levels above 177 pCi g^{-1} solids. However HCl leaching of the radium preleached Midwest Lake uranium ore provided the best extraction of U(>99%), Ni(88%), As(90%) and Ra (98%) and the tailings with only 108 pCi g^{-1} solids radium. Of course, out of these 108 pCi/g solids, at least 66 pCi/g solids were tied up with the residual uranium (0.02%) in the tailings, and the remaining radium (42 pCi/g solids) present as sparingly soluble radium salt/salts (e.g., $RaSO_4$). The acid chloride leaching process for uranium ore has definite technological and environmental merits but presently compares unfavourably both in capital and operating costs with the conventional sulphuric acid leach process. However, the economics of the HCl leach process could become viable when the costs of removing the radium (226) and the sulphides (i.e., the acid generating minerals) from sulphuric acid leach tailings are taken into consideration.

14214 (INIS-mf–12807, pp. 8.1-8.10) **UO_2 fuel pellet manufacture.** Hoare, M.R. (Zircatec Precision Industries Inc., Port Hope, ON (Canada)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

The UO_2 pellet fabrication process used by a principal CANDU fuel manufacturer is described. High pellet quality and favourable process economics are very dependent on the supply of ceramic grade UO_2 powder possessing consistently reproducible chemical and physical properties. The paper discusses the importance and influence of the starting powder properties on the pellet process and describes some of the more serious processing problems that have been encountered in recent years. The paper also reviews experience with small scale manufacture of enriched UO_2 pellets and addresses some of the additional problems that are imposed by enrichment. This is extended into brief consideration of large scale manufacture of slightly enriched fuel (SEU).

14215 (INIS-mf–12807, pp. 8.11-8.15) **Lab-scale fuel fabrication facility: Planning and implementation.** Abdelrazek, I.D. (National Research Centre, Cairo (Egypt). Metallurgy Lab.); El Sayed, A.A. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

A lab-scale fuel fabrication plant of several kilograms/year capacity is described. Zoning of the different activities along with a layout of the machinery and equipment are shown. A comprehensive description of the equipment is also given. The chemical processes associated with the production include precipitation (AUC process), followed by filtration, calcination, pelletization, sintering and grinding. A description of the fabrication of fuel pins (50 cm long) of uranium dioxide pellets, cladded in zircaloy tubing, is also included. The QC procedures associated with all stages in the plant are also indicated. Future plans for irradiation, post irradiation examination, and reporting of the fuel behaviour are also discussed.

14216 (RISO-M–2876) **Uranium recovery by leaching with sodium carbonate at high temperature and pressure.** Soerensen, E.; Koefoed, S.; Lundgaard, T. Risoe National Lab., Roskilde (Denmark). Chemistry Dept. Sep 1990. 93p. Order Number DE91624284. Source: OSTI; NTIS (US Sales Only); INIS.

EFP- Kvanefjeld uranium project. Originally published in Danish in 1983, which is available as INIS-MF-8991.

An alkaline rock from the Ilimaussaq instrusion, SW Greenland, was proposed as a source of uranium. Its principal uranium bearing mineral, Steenstrupine, is a complex sodium REE phosphosilicate in which Fe, Mn, Th and U are minor constituents. A special feature of this ore body is the content of water soluble minerals: NaF (Villiaumite), $Na_2Si_2O_5$ (Natrosilite) and an organic substance which displays the characteristics of humus. Sulfides are sparse, the most important one being ZnS (Sphalerite) of which the content is generally less than 0.5%. In the mineral under consideration (Lujavrite) the Steenstrupine is mainly finelay disseminated throughout the rock, yielding a uranium content of 300-400 ppm and thorium content of 800-1000 ppm. Laboratory tests indicated that high temperature carbonate leaching was necessary to decompose Steenstrupine. The optium temperature was shown to be 260 deg. C and the leach liquor composition 120 g/l of $NaHCO_3$ and 20 g/l of Na_2C0_3. Addition of oxygen is necessary. The process was developed to industrial scale in a continuous pipe autoclave with a retention time of 20 min. After filtering on a belt filter, the liquor was recycled several times to obtain a higher U-concentration. By reductive precipitation with iron powder a raw UO_2 was obtained. It was purified after dissolution in HNO_3. An overall yield of 80% could be obtained. (author) 32 tabs., 13 ills., 24 refs.

0505 Uranium Enrichment

Refer also to citation(s) 14343

14217 (CONF-910659–1) **Investigation of gas-phase decontamination of internally radioactively contaminated gaseous diffusion process equipment and piping.** Bundy, R.D.; Munday, E.B. Oak Ridge K-25 Site, TN (USA). [1991]. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OT21400. From 84. annual meeting and exhibition of the Air and Waste Management Association (AWMA); Vancouver (Canada); 16-21 Jun 1991. Order Number DE91008807. Source: OSTI; NTIS; INIS; GPO Dep.

Construction of the gaseous diffusion plants (GDPs) was begun during World War 2 to produce enriched uranium for defense purposes. These plants, which utilized UF_6 gas, were used primarily for this purpose through 1964. From 1959 through 1968, production shifted primarily to uranium enrichment to supply the nuclear power industry. Additional UF_6-handling facilities were built in feed and fuel-processing plants associated with the uranium enrichment process. Two of the five process buildings at Oak ridge were shut down in 1964. Uranium enrichment activities at Oak Ridge were discontinued altogether in 1985. In 1987, the Department of Energy (DOE) decided to proceed with a permanent shutdown of the Oak Ridge Gaseous Diffusion Plant (ORGDP). DOE intends to begin decommissioning and decontamination (D&D) of ORGDP early in the next century. The remaining two GDPs are expected to be shut down during the next 10 to 40 years and will also require D&D, as will the other UF_6-handling facilities. This paper presents an investigation of gas- phase decontamination of internally radioactively contaminated gaseous diffusion process equipment and piping using powerful fluorinating reagents that convert nonvolatile uranium compounds to volatile UF_6. These reagents include ClF_3, F_2, and other compounds. The scope of D&D at the GDPs, previous work of gas-phase decontamination, four concepts for using gas-phase decontamination, plans for further study of gas-phase decontamination, and the current status of this work are discussed. 13 refs., 15 figs.

14218 (INIS-mf–12806, pp. 114-121) **New technology for uranium enrichment: What can the customer expect?.** Schwennesen, J.L. (Department of Energy, Washington, DC (USA). Office of Uranium Resources and Enrichment). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The author reviews new enrichment technologies from the perspective of their impact upon the availability, economics, and security of supply of enriched uranium. Two very attractive enrichment technologies, advanced gas centrifugation and atomic vapour laser isotope separation, are available to the United States. Both should be fully demonstrated in the mid-1980s and should reduce U.S. SWU prices considerably to about $50 or less by the year 2000. World enrichment supplies are adequate to meet demand.

14219 (INIS-mf–12806, pp. 122-123) **Uranium enrichment in Japan.** Inoue, K. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)); Isetani, M.; Nishikado, G.; Shirahashi, J. Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver

(Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

A uranium enrichment pilot plant that uses the gas centrifugation process came into full operation in 1982. Japanese utilities expect the demand for enrichment services to be about 8 million SWU/y for 1990 and 12 million SWU/y for 2000. Although most enrichment services needed up to the year 2000 have been secured, domestic production capability is needed to ensure security of supply. Japan will proceed to commission a commercial enrichment plant by 1990; its capacity should reach 3 million SWU/y by 2000. Research continues into improvements in the centrifuge process.

14220 (INIS-mf-12807, pp. 6.4-6.6) **Development of uranium enrichment.** Li Can (Shanghai Inst. of Radiation Medicine, SH (China)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943-: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Nuclear Fuel Bureau of Ministry of Nuclear Industry (MNI) of China has experiences of diffusion enrichment. This paper describes the development and comparison of the different enrichment techniques. It deals with the centrifuge development currently being undertaken in China. It also describes the status of R and D work about Laser Isotope Separation. The paper concludes with our preference of development programme on uranium enrichment.

0507 Fuels Production and Properties

Refer also to citation(s) 14224, 14350, 14584, 14607

0508 Spent Fuels Reprocessing

Refer also to citation(s) 14235, 14266, 14288, 14324, 14341

14221 (CEA-CONF-10424) **Behavior of ruthenium in the case of shutdown of the cooling system of HLLW storage tanks.** Philippe, M.; Mercier, J.P.; Gue, J.P. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). 1990. 13p. (CONF-900809-: 21. DOE/NRC nuclear air cleaning conference, San Diego, CA (USA), 13-16 Aug 1990). Order Number DE91762820. Source: OSTI; NTIS (US Sales Only).

The consequences of the failure of the cooling system of fission product storage tanks over a variable period were investigated as part of the safety analysis of the La Hague spent fuel reprocessing plant. Due to the considerable heat release, induced by the fission products, a prolonged shutdown of the tank cooling system could cause the progressive evaporation of the solutions to dryness, and culminate in the formation of volatile species of ruthenium and their release in the tank venting circuit. To determine the fraction of ruthenium likely to be transferred from the storage tanks in volatile or aerosol form during the failure, evaporation tests were conducted by evaporating samples of actual nitric acid solutions of fission products, obtained on the laboratory scale after the reprocessing of several kilograms of MOX fuels irradiated to 30,000 MWday.t^{-1}. A distillation apparatus was designed to operate with small volume solution samples, reproducing the heating conditions existing in the reprocessing plant within a storage tank for fission products. The main conclusions drawn from these experiments are as follows: - ruthenium is only volatilized in the final phase of evaporation, just before desiccation, - for a final temperature limited to 160^{0}C, the total fraction of volatilized ruthenium reaches 12%, in the presence of H_20, $HN0_3$, $N0_x$ and 0_2, the volatilized ruthenium recombines mainly in the form of ruthenium nitrosyl nitrates, or decomposes into ruthenium oxide on the walls of the apparatus. Assuming a heating power density of 10 W/liter of concentrate, and a perfectly adiabatic storage system, the minimum time required to reach dryness can be estimated at 90 h, allowing substantial time to take action to restore a cooling source.

14222 (CEA-CONF-10425) **Diapason: an assistant system for supervision.** Coudouneau, L.; Leyval, L.; Montmain, J.; Penaiva, J.M. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France). 1990. 15p. (In French). (CONF-9005340-: 10. International days on Expert Systems and their Applications, Avignon (France), 28 May - 1 jun 1990). Order Number DE91767716. Source: OSTI; NTIS (US Sales Only).

Simulation and assisted diagnosis are the contributions DIAPASON provides to supervision. The reasonings are based on a qualitative model, a knowledge base and a set of constraints on the values of the process variables, all three issued from a single representation of the process. After an overview of the qualitative simulation, the on line interpretation of the latter and the heuristic diagnosis, the cooperation of these three units is pointed out.

14223 (CEA-CONF-10426) **Sagace: a representation of knowledge for supervision of continuous process.** Penalva, J.M. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France). 1990. 15p. (In French). (CONF-9005340-: 10. International days on Expert Systems and their Applications, Avignon (France), 28 May - 1 jun 1990). Order Number DE91767715. Source: OSTI; NTIS (US Sales Only).

The aim of the SAGACE project is to meet the requirements of the conception of supervision systems for continuous processes by proposing a modelling language. It would make easier the knowledge acquisition about the process by warranting the representation coherence in order to infer validated operational models. In addition to the flexibility, simplicity and generality of a graphic language issued from SADT, the main idea is that knowledge acquisition and organization are the purposes of this language which rests on a modelling theory. The application domain is chemical engineering and more precisely a nuclear wastes retreatment plant.

14224 (INIS-mf-12806, pp. 129-133) **Fuel recycle in Japan.** Murata, H. (Japan Atomic Industrial Forum, Inc., Tokyo (Japan)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934-: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

It has been the policy of the Japanese Atomic Energy Commission that all spent fuel from the Japanese nuclear power program should be recycled in order to make effective use of limited uranium resources. Japan can carry on most of the steps of the nuclear fuel cycle: uranium enrichment, reactor fuel element fabrication, reprocessing, and MOX fuel element fabrication. This paper reviews some problems to be solved in regard to the development of advanced power reactors, plutonium MOX fuel development, plutonium recycling, and the fate of depleted uranium recovered from reprocessing.

14225 (INIS-mf-12807, pp. 6.1-6.3) **A new approach to uranium chemistry completing the nuclear fuel cycle.** Michallet, M.F. (Compagnie Generale des Matieres Nucleaires (COGEMA), 26 - Pierrelatte (France)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943-: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

COGEMA has developed a number of chemical plants at the Tricastin site in southern France, capable of converting uranium to a variety of different oxides and by-products. The initial compounds are depleted uranium hexafluoride from the bottom of the Eurodif enrichment cascade; and pure uranyl nitrate from the U/Pu separations in the La Hague reprocessing plant.

0509 Transport, Handling, and Storage

Refer also to citation(s) 14245, 14299, 14311, 14328, 15012, 15793

14226 (CONF-910603-1) **Generic criticality safety issues.** Hively, L.M. Oak Ridge National Lab., TN (USA). [1991]. 3p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From Annual meeting of the American Nuclear Society (ANS); Orlando, FL (USA); 2-6 Jun 1991. Order Number DE91006335. Source: OSTI; NTIS; GPO Dep.

An independent group has been designated by Martin Marietta Energy Systems, Inc., (MMES) to internally review Safety Analysis

Reports for Packaging (SARPs) that describe containers for shipment of radioactive material. This group is called the Energy Systems Independent Review Group (ESIRG), reporting to the MMES Transportation Safety Manager as part of a central staff function. The ESIRG focus is Y-12 Plant packages, with additional review responsibilities for the Paducah Tiger UF_6 overpack and 6M package. Review questions are posed directly to the SARP preparers. This paper addresses three generic issues that arose during the ESIRG criticality reviews: analysis tools, uncertainties in results, and resulting (finite) probability of criticality. 6 refs., 1 tab.

14227 (INIS-mf–12807, pp. 4.21-4.26) **Nuclear accountability in dry vault storage.** Ealing, C.J. (CEC Energy Systems Limited, Whetstone, Leicester (UK)); Cundill, B.R. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Verification of storage by physical inventory checks using optical surveillance and fissile material content checks by Non Destructive Assay (NDA) are difficult to achieve at acceptable costs in many dry storage systems. The Modular Dry Vault Store (MVDS) allows direct optical inspection, NDA survey of individual fuel assemblies and monitoring of the gaseous storage environment for each fuel assembly without significant capital or operating costs. MVDS has been developed for the interim dry storage of LWR fuel but can also be applied to all fuel types, including CANDU and to the storage of vitrified fuel reprocessing wastes.

14228 (INIS-SU–231, pp. 85-87) **Shielding materials for transport package sets.** Kondrat'ev, A.N.; Lebedenko, S.G.; Revun, Yu.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

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Requirements for shielding materials for spent nuclear fuels transportation, are formulated. Calculated and experimental investigations of radiation attenuation at different shielding compositions are carried out. It is shown that composition of steel and borated titanium hydride is the most efficient with respect to total attenuation of γ radiation and neutron flux. This composition is the most efficient for transportation of fuels with high burnup in gaseous coolant.

14229 (ORNL/FTR–3873) **[Transportation of low-specific-activity radioactive materials and surface-contaminated objects]: Foreign trip report, March 5–7, 1991.** Rawl, R.R. Oak Ridge National Lab., TN (USA). 22 Mar 1991. 59p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91009783. Source: OSTI; NTIS; GPO Dep.

The traveler participated in a consultants' meeting sponsored by the International Atomic Energy Agency to consider several issues related to the transportation of low-specific-activity radioactive materials and surface-contaminated objects. Several problems identified by member states and issues raised during the ongoing revision of the transportation regulations were addressed. Proposed solutions to these issues and problems were developed and will be presented for consideration during the revision process. Specific issues addressed included: creation of a new category for solidified low-specific-activity materials which exhibit high radiation levels and development of suitable packaging requirements for these materials; addition of mill tailings-type materials to the easiest-to-transport category of materials, Low Specific Activity Category I (LSA-I); and inclusion of a generic description of very-low-specific-activity materials within the LSA-I category.

14230 (SAND–90-2572) **Recommendations for cask features for robotic handling from the Advanced Handling Technology Project.** Drotning, W. Sandia National Labs., Albuquerque, NM (USA). Feb 1991. 34p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009729. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes the current status and recent progress in the Advanced Handling Technology Project (AHTP) initiated to explore the use of advanced robotic systems and handling technologies to perform automated cask handling operations at radioactive waste handling facilities, and to provide guidance to cask designers on the impact of robotic handling on cask design. Current AHTP tasks have developed system mock-ups to investigate robotic manipulation of impact limiters and cask tiedowns. In addition, cask uprighting and transport, using computer control of a bridge crane and robot, were performed to demonstrate the high speed cask transport operation possible under computer control. All of the current AHTP tasks involving manipulation of impact limiters and tiedowns require robotic operations using a torque wrench. To perform these operations, a pneumatic torque wrench and control system were integrated into the tool suite and control architecture of the gantry robot. The use of captured fasteners is briefly discussed as an area where alternative cask design preferences have resulted from the influence of guidance for robotic handling vs traditional operations experience. Specific robotic handling experiences with these system mock-ups highlight a number of continually recurring design principles: (1) robotic handling feasibility is improved by mechanical designs which emphasize operation with limited dexterity in constrained workspaces; (2) clearances, tolerances, and chamfers must allow for operations under actual conditions with consideration for misalignment and imprecise fixturing; (3) successful robotic handling is enhanced by including design detail in representations for model-based control; (4) robotic handling and overall quality assurance are improved by designs which eliminate the use of loose, disassembled parts. 8 refs., 15 figs.

0510 Economic, Industrial, and Business Aspects

Refer also to citation(s) 14218, 14219

14231 (INIS-mf–12806, pp. 86-88) **Megatrends in the nuclear fuel business.** Wolcott, J.R. (Nuclear Exchange Corp., Denver, CO (USA)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The fuel side of the nuclear industry has had a difficult decade. Prices rose and fell sharply; supply and demand became far out of balance; mines closed while new, high-grade deposits were developed. The United States reduced production by two-thirds within a few years. The centre of Canadian production moved west. Although there are still problems, there are signs that the next decade will be calmer. Today the excess of production over consumption is not so large as it has been, prices are improving, and market changes are less violent. There will still be uncertainties, but the controlling variables are stabilizing. Estimates of future consumption have a much more solid basis than they had in the early 70s.

14232 (INIS-mf–12806, pp. 89-94) **Canada's role as a uranium supplier.** Morrison, R.W. (Department of Energy, Mines and Resources, Ottawa, ON (Canada)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Canada's existing uranium mines can produce sufficient uranium to meet both domestic and foreign demand well into the 1990s. In order to develop further resources, a secure market will be needed to make the investment in building up remote facilities worthwhile. It is Canadian government policy to maintain a healthy national uranium industry to be a secure supplier of uranium for peaceful purposes over the longer term.

14233 (INIS-mf–12806, pp. 95-98) **Australia's uranium supply potential.** Grey, A.J. (Pancontinental Mining Ltd., Sydney

(Australia)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Australia's uranium supply potential has been, and continues to be, dependent on the political situation in that country. The author reviews the history of government policies on uranium export and resource development in the 1970s and early 1980s. Australia has 20 percent of the world's less expensive uranium, and 25 percent of the more expensive resources, with more being discovered all the time. The author surveys the existing and potential uranium production centres.

14234 (INIS-mf–12806, pp. 99-100) **The consumer's viewpoint.** Tanaka, Y. (Japan Atomic Power Co., Tokyo (Japan)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Nuclear power is a mainstay of the Japanese energy economy, but Japan depends almost exclusively on imports for her uranium resources. In order to ensure a secure supply, Japan has adopted four strategies: overseas exploration, participation in overseas uranium development, long-term uranium supply contracts, and stockpiling of uranium.

14235 (INIS-mf–12806, pp. 134-138) **Fuel recycle in the U.S.: Significance, status, constraints and prospects.** Wolfe, B. (General Electric Uranium Management Corp., Fairfield, CT (USA)); Judson, B. Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Since the mid-seventies reprocessing and plutonium recycle have not been legally sanctioned in the U.S., nor is reprocessing economic. Instead, the once-through fuel cycle has been accepted as the practical and economic option. The major remaining task is the completion of a waste repository before the end of the century. One of the other key issues is how best to preserve the option for plutonium utilization in the future, should it become legal and economic.

14236 (INIS-mf–12807 P.1-P.8) **The role of uranium in the world's energy supply.** Runnalls, O.J.C. (Toronto Univ., ON (Canada)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Uranium as an energy source is a relative newcomer to the world energy scene. Commercial nuclear power reactors first began to operate only three decades ago. Meanwhile, their contribution has grown rapidly so that today more than 15% of the world's electricity is supplied by the fissioning of uranium. Significant growth in uranium consumption is foreseen for at least the next three decades. If growth occurs at low estimated rates for nuclear plant installations, current delineated uranium resources should provide adequate fuel for the nuclear industry. If higher growth estimates are realized, increased uranium utilization may be required through the development of more efficient nuclear fuel cycles.

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Refer also to citation(s) 14203, 14204, 14229, 14321, 14333, 14334, 14336, 14338, 14344, 14600, 14603, 14687, 14688, 14940, 14941, 14942, 14981, 14992, 14993, 15216, 15273, 15274, 15275, 15330, 15432, 15447, 15448, 15449, 15450, 15786, 15794

14237 (CEA-CONF–10423) **Elimination of iodine from radioactive gaseous effluents in a packed column.** Vignau, B. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (FR)); Goumondy, J.P.; Roustan, M. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France). 1990. 12p. (CONF-900809–: 21. DOE/NRC nuclear air cleaning conference, San Diego, CA (USA), 13-16 Aug 1990). Order Number DE91762819. Source: OSTI; NTIS (US Sales Only).

Iodine is eliminated from the gaseous radioactive effluent of a reprocessing plant in a packed column. Iodine is absorbed in a 0.5 N sodium-hydroxyde solution. The Kinetics of I_2-air-NaOH are known: it is an instantaneous interface reaction where the important parameters are the interface surface area and the gas film mass transfer coefficient K_G. The hydrodynamic characteristics of different kinds of packing (Raschig rings, Berl saddles, Multiknit) were determined with a column of 0.1 m in diameter and 2 m high. The pressure drop, dynamic holdup, effective interface surface area, axial dispersion coefficient were determined. The mass transfer coefficient K_G for the I_2-air-NaOH system was investigated in the column filled with glass Raschig rings. About 10 experiments were conducted because it is difficult to make experiments with this system. So we have used another well known system (CO_2-air-NaOH$\approx$1.8 N) to determine K_G.

14238 (CEA-CONF–10428) **Incineration of technological waste contaminated with alpha emitters.** Otter, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR)); Moncouyoux, J.P.; Cartier, R.; Durec, J.P.; Afettouche, R. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). 1990. 9p. (In French). (CONF-9005123–: 1990 incineration conference: 9th annual international symposium on the incineration of radioactive, hazardous, mixed and medical wastes, San Diego, CA (USA), 14-18 May 1990). Order Number DE91762824. Source: OSTI; NTIS (US Sales Only).

A large R and D programme is in progress at the CEA on alpha-bearing waste incineration. The program is developed in the laboratory and a pilot plant including the following aspects: physico-chemical characterization of wastes, study of thermal decomposition of wastes, laboratory study of generated gases (first with inactive then with active wastes), development of an industrial pilot plant with inactive wastes, study of corrosion resistance of material (laboratory and pilot plant), study and qualification of nuclear measurements on wastes, ashes and equipment.

14239 (CEA-CONF–10430) **New volume reduction conditioning options for solid alpha-bearing waste.** Jouan, A. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (FR)); Jacquet-Francillon, N.; Kertesz, C.; Frotscher, H.; Ganser, B.; Klein, M. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France). 1990. 12p. (CONF-9009208–: 3. European community conference on radioactive waste management and disposal, Luxembourg (Luxembourg), 17-21 Sep 1990). Order Number DE91762818. Source: OSTI; NTIS (US Sales Only).

The current and future development of nuclear energy requires increasing allowance for nuclear waste treatment: α-bearing wastes destined for geological storage are already conditioned, generally in a cement matrix. Other containment processes producing higher quality matrices and allowing volume reduction have been investigated over the last five years by the General Directorate for Science Research and Development of the Commission of the European Communities. This paper discusses the work on conditioning α-bearing ashes produced by incineration of contaminated combustible materials, and on fuel cladding hulls resulting from spent fuel reprocessing.

14240 (CEA-CONF–10431) **Incineration ash conditioning processes.** Jouan, A.; Ouvrier, N.; Teulon, F. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France). 1990. 7p. (CONF-9005123–: 1990 incineration conference: 9th annual international symposium on the incineration of radioactive, hazardous, mixed and medical wastes, San Diego, CA (USA), 14-18 May 1990). Order Number DE91762825. Source: OSTI; NTIS (US Sales Only).

Incinerable wastes consist of the following standard composition corresponding to projected wastes from a future mixed oxide fuel fabrication plant with an annual throughput of 1700 kg (i.e. 5.7 m^3) of ashes produced by the incineration facility: . 50% polyvinyl chloride (glove box sleeves), . 5% polyethylene (bags), . 35% rubber (equal amounts of latex and neoprene), . 10% cellulose (equal amounts of cotton and cleansing tissues). The work focused mainly

on compaction by high-temperature isostatic pressing, is described in some detail with the results obtained. An engineering study was also carried out to compare this technology with two other ash containment processes: direct-induction (cold crucible) melting and cement-resin matrix embedding. Induction melting is considerably less costly than isostatic pressing; the operating costs are about 1.5 times higher than for cement-resin embedding, but the volume reduction is nearly 3 times greater.

14241 (CONF-870511–8) **Systematic approach for the design of pumpable cement-based grouts for immobilization of hazardous wastes.** Sams, T.L.; Gilliam, T.M. Oak Ridge National Lab., TN (USA). [1987]. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 4. international hazardous waste symposium on environmental aspects of stabilization-solidification of hazardous and radioactive wastes; Atlanta, GA (USA); 3-6 May 1987. Order Number DE91009651. Source: OSTI; NTIS; INIS; GPO Dep.

Cement-based grouts have been proven to be an economical and environmentally acceptable means of waste disposal. Costs can be reduced if the grout is pumped to the disposal site. This paper presents a systematic approach to guide the development of pumpable grouts. 20 refs., 2 figs.

14242 (CONF-910659–2) **Physical/chemical treatment of mixed waste soils.** Morris, M.I. (Oak Ridge National Lab., TN (USA)); Alperin, E.S.; Fox, R.D. Oak Ridge National Lab., TN (USA). [1991]. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 84. annual meeting and exhibition of the Air and Waste Management Association (AWMA); Vancouver (Canada); 16-21 Jun 1991. Order Number DE91009143. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the results and findings of the demonstration testing of a physical/chemical treatment technology for mixed wastes. The principal objective of the tests was to demonstrate the capability of the low temperature thermal separation (LTTS) technology for rendering PCB-contaminated mixed waste soils as nonhazardous and acceptable for low level radioactive waste disposal. The demonstration testing of this technology was a jointly-conducted project by the US Department of Energy (DOE), the Martin Marietta Energy Systems (Energy Systems) Waste Management Technology Center at the Oak Ridge National Laboratory, and IT Corporation. This pilot-scale demonstration program testing of IT's thermal separator technology in Oak Ridge was conducted as part of the DOE Model Program. This program has private industry, regulators, and universities helping to solve DOE waste management problems. Information gained from the DOE Model is shared with the participating organizations, other federal agencies, and regulatory agencies. The following represent the most significant findings from these demonstration tests: Thermal separation effectively separated PCB contamination from a mixed waste to enable the treated soil to be managed as low level radioactive waste. At the same operating conditions, mercury contamination of 0.8 ppM was reduced to less than 0.1 ppM. The majority of uranium and technetium in the waste feeds oil remained in the treated soil. Radionuclide concentration in cyclone solids is due to carry-over of entrained particles in the exit gas and not due to volatilization/condensation. Thermal separation also effectively treated all identified semi-volatile contaminants in the waste soil to below detection limits with the exception of di-n-butylphthalate in one of the two runs. 4 refs., 1 fig., 6 tabs.

14243 (CONF-8609486–1) **Immobilization of neutralized cladding-removal waste in a cement-based grout.** Sams, T.L.; McDaniel, E.W.; Gilliam, T.M. Oak Ridge National Lab., TN (USA). [1986]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 2. Canadian Nuclear Society international conference on radioactive waste management; Winnipeg (Canada); 7-11 Sep 1986. Order Number DE91009640. Source: OSTI; NTIS; INIS; GPO Dep.

Oak Ridge National Laboratory (ORNL) is providing technical support for the Transportable Grout Facility (TGF) currently being designed by Rockwell Hanford Operations in Richland, Washington. The grout formulas to be used in the TGF for disposal of low-level radioactive waste streams are being developed at ORNL. One such waste stream, neutralized cladding-removal waste (NCRW), has been identified for disposal, and a grout formula has subsequently been developed. The development of this formula required extensive testing to achieve adherence to several performance criteria. Both the grout formula and the results of this testing are presented. 9 refs., 3 figs., 5 tabs.

14244 (DOE/CH/10332–1) **Infrared and Raman investigation of rare-earth phosphate glasses for potential use as radioactive waste forms: Final Report.** Morgan, S.H. Fisk Univ., Nashville, TN (USA). Dept. of Physics. Jan 1989. 28p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-87CH10332. Order Number DE91009789. Source: OSTI; NTIS; INIS; GPO Dep.

This project was designed to investigate the properties of the rare-earth phosphate glass systems CeO_2-P_2O_5 and Pr_2O_3-P_2O_5 for potential use as radioactive waste glasses. The glass-forming region and optimum processing parameters of these glass systems were investigated. The structure of the host glasses and glassed loaded with simulated waste elements was investigated using Raman and infrared spectroscopy. Because of the radical differences in the spectra of the molybdenum-loaded glasses, the structure of the MoO_3-P_2O_5 glass system was also investigated. 29 refs., 8 figs., 2 tabs.

14245 (DOE/CH/10402–8) **Midwestern High-Level Radioactive Waste Transportation Primer: (Draft).** Dantoin, T.S. Council of State Governments, Lombard, IL (USA). Midwestern Office. Feb 1991. 104p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC02-89CH10402. Order Number DE91010001. Source: OSTI; NTIS; INIS; GPO Dep.

The Midwestern High-level Radioactive Waste Transportation Primer was prepared for the purpose of identifying and analyzing regional issues pertaining to the transportation of high-level radioactive waste and to inform Midwestern state officials with respect to technical issues and regulatory concerns related to waste transportation. The report contains an introduction which presents historical information and a discussion of public opinion regarding nuclear power and its economic competitiveness. Section 1 discusses the Civilian Radioactive Waste Management Program including the need for a waste disposal program, requirements of the Nuclear Waste Policy Act (NWPA) as amended, and obstacles to implementing the NWPA. Section 2 presents the technical program with discussions of waste generators, the monitored retrievable storage facility, the geologic repository, and the transportation system. Section 3 discusses the institutional program with respect to the federal government; states, tribes, and other interested parties; and transportation issues including modal mix, highway routing, rail routing, safeguarding shipments, accident reporting, transporting defense wastes, emergency preparedness and response, training, liability, inspection and enforcement, and state, tribal, and local regulation of transportation. 165 refs., 20 figs., 29 tabs. (MB)

14246 (DOE/NV–91009791) **Yucca Mountain Project: ESF Title I design control process review report.** USDOE Nevada Operations Office, Las Vegas, NV (USA). Yucca Mountain Project Office. 19 Jan 1989. 290p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009791. Source: OSTI; NTIS; INIS; GPO Dep.

The Exploratory Shaft Facility (ESF) Title 1 Design Control Process Review was initiated in response to direction from the Office of Civilian Radioactive Waste Management (OCRWM) (letter: Kale to Gertz, NRC Concerns on Title 1 Design Control Process, November 17, 1988). The direction was to identify the existing documentation that described "··· the design control process and the quality assurance that governed ···" (a) the development of the requirements documents for the ESF design, (b) the various interfaces between activities, (c) analyses and definitions leading to additional requirements in the System Design Requirements Documents and, (d) completion of Title 1 Design. This report provides historical information for general use in determining the extent of the quality assurance program in existence during the ESF Title 1 Design.

14247 (DOE/OSTI–3406-Suppl.2-Add.1) **Yucca Mountain Project bibliography, January–June 1989: An update: Supplement 2, Add. 1.** USDOE Office of Scientific and Technical

Information, Oak Ridge, TN (USA). 1990. 1p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91000566. Source: OSTI; NTIS; INIS; GPO Dep.

Following a reorganization of the Office of Civilian Radioactive Waste Management, the Yucca Mountain Project was renamed Yucca Mountain Site Characterization Project. The title of this bibliography was also changed to Yucca Mountain Site Characterization Project Bibliography. Prior to August 5, 1988, this project was called the Nevada Nuclear Waste Storage Investigations. This bibliography contains information on this ongoing project that was added to the Department of Energy's Energy Science and Technology Database from January 1990 through June 1990. The bibliography is categorized by principal project participating organization. Participant-sponsored subcontractor reports, papers, and articles are included in the sponsoring organization's list. Another section contains information about publications on the Energy Science and Technology Database that were not sponsored by the project but have some relevance to it.

14248 (DOE/RL–88-30-Rev.1-Vol.1) **Hanford Site Waste Management Units Report: Revision 1, Volume 1.** USDOE Richland Operations Office, WA (USA). Jan 1991. 512p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91009364. Source: OSTI; NTIS; INIS; GPO Dep.

This Hanford Site Waste Management Units Report (HSWMUR) was originated to provide information responsive to Section 3004(u) of the Hazardous and Solid Waste Amendments (HSWA) of the 1984 United States Code (USC). The report provides a comprehensive inventory of all types of waste management units at the Hanford Site and consists of waste disposal units, including (1) Resource Conservation and Recovery Act of 1976 (RCRA) disposal units, (2) Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) disposal units, (3) unplanned releases, (4) inactive contaminated structures, (5) RCRA treatment and storage units, and (6) other storage areas. Because of the comprehensive nature of this report, the listing of sites is more extensive than required by Section 3004(u) of HSWA. In support of the Hanford RCRA permit, a field was added to designate whether the waste management unit is a solid waste management unit (SWMU). As SWMUs are identified, they will added to the Hanford Waste Information Data System (WIDS), which is the database supporting this report, and added to the report at its next annual update. A quality review of the WIDS was conducted this past year. The review included checking all data against their reference and making appropriate changes, updating the data elements using the most recent references, marking duplicate units for deletion, and adding additional information. 6 refs.

14249 (DOE/RL–88-30-Rev.1-Vol.2) **Hanford Site Waste Management Units Report: Revision 1, Volume 2.** USDOE Richland Operations Office, WA (USA). Jan 1991. 493p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91009413. Source: OSTI; NTIS; INIS; GPO Dep.

This Hanford Site Waste Management Units Report (HSWMUR) was originated to provide information responsive to Section 3004(u) of the Hazardous and Solid Waste Amendments (HSWA) of the 1984 United States Code (USC). The report provides a comprehensive inventory of all types of waste management units at the Hanford Site and consists of waste disposal units, including (1) Resource Conservation and Recovery Act of 1976 (RCRA) disposal units, (2) Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) disposal units, (3) unplanned releases, (4) inactive contaminated structure, (5) RCRA treatment and storage units, and (6) other storage areas. Because of the comprehensive nature of this report, the listing of sites is more extensive than required by Section 3004(u) of HSWA. In support of the Hanford RCRA permit, a field was added to designate whether the waste management unit is a solid waste management unit (SWMU). As SWMUs are identified, they will added to the Hanford Waste Information Data System (WIDS), which is the database supporting this report, and added to the report at its next annual update. A quality review of the WIDS was conducted this past year. The review included checking all data against their reference and making appropriate changes, updating the data elements using the most recent references, marking duplicate units for deletion, and addition additional information. 6 refs.

14250 (DOE/RL–90-38) **Hanford Site Solid Waste Landfill permit application.** USDOE Richland Operations Office, WA (USA). Jan 1991. 872p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91009386. Source: OSTI; NTIS; INIS; GPO Dep.

Daily activities at the Hanford Site generate sanitary solid waste (nonhazardous and nonradioactive) that is transported to and permanently disposed of at the Hanford Site Solid Waste Landfill. This permit application describes the manner in which the solid Waste Landfill will be operated under Washington State Department of Ecology Minimum Functional Standards for Solid Waste Handling, Washington Administrative Code 173-304. The solid Waste Landfill is owned by the US Department of Energy – Richland Operations Office and is used for disposal of solid waste generated at the US Department of Energy Hanford Site. The jurisdictional health department's permit application form for the Solid Waste Landfill is provided in Chapter 1.0. Chapter 2.0 provides a description of the Hanford Site and the Solid Waste Landfill and reviews applicable locational, general facility, and landfilling standards. Chapter 3.0 discusses the characteristics and quantity of the waste disposed of in the Solid Waste Landfill. Chapter 4.0 reviews the regional and site geology and hydrology and the groundwater and vadose zone quality beneath the landfill. Chapters 5.0, 6.0, and 7.0 contain the plan of operation, closure plan, and postclosure plan, respectively. The plan of operation describes the routine operation and maintenance of the Solid Waste Landfill, the environmental monitoring program, and the safety and emergency plans. Chapter 5.0 also addresses the operational cover, environmental controls, personnel requirements, inspections, recordkeeping, reporting, and site security. The postclosure plan describes requirements for final cover maintenance and environmental monitoring equipment following final closure. Chapter 8.0 discusses the integration of closure and postclosure activities between the Solid Waste Landfill and adjacent Nonradioactive Dangerous Waste Landfill. 76 refs., 48 figs, 15 tabs.

14251 (DOE/RL–91-06-Vol.1-Pt.1) **Hanford Site annual dangerous waste report: Volume 1, Part 1: Generator dangerous waste report, Dangerous waste: Calendar year 1990.** USDOE Richland Operations Office, WA (USA); Westinghouse Hanford Co., Richland, WA (USA). [1990]. 496p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91010841. Source: OSTI; NTIS; GPO Dep.

This volume contains information for the treatment, storage, and disposal facilities of dangerous wastes generated at Hanford Reservation for the 1990 calendar year. (KJD)

14252 (DOE/RL–91-06-Vol.1-Pt.2) **Hanford Site annual dangerous waste report: Volume 1, Part 2: Generator dangerous waste report, Dangerous waste: Calendar year 1990.** USDOE Richland Operations Office, WA (USA); Westinghouse Hanford Co., Richland, WA (USA). [1990]. 479p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91010842. Source: OSTI; NTIS; GPO Dep.

This document, Volume 1, Part 2, contains information for the treatment, storage, and disposal facilities of dangerous wastes generated at Hanford Reservation for the 1990 calendar year. (KJD)

14253 (DOE/RL–91-06-Vol.2) **Hanford Site annual dangerous waste report: Volume 2, Generator dangerous waste report, Radioactive mixed waste: Calendar year 1990.** USDOE Richland Operations Office, WA (USA); Westinghouse Hanford Co., Richland, WA (USA). [1990]. 289p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91010843. Source: OSTI; NTIS; GPO Dep.

This document, Volume 2, contains information for the treatment, storage, and disposal facilities of dangerous wastes generated at Hanford Reservation for the 1990 calendar year. (KJD)

14254 (DOE/RL–91-06-Vol.3-Pt.1) **Hanford Site annual dangerous waste report: Volume 3, Part 1: Waste management facility report, Dangerous waste: Calendar year 1990.** USDOE Richland Operations Office, WA (USA); Westinghouse Hanford Co.,

Richland, WA (USA). 1990. 483p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91010844. Source: OSTI; NTIS; GPO Dep.

This document, Volume 3, contains information for the treatment, storage, and disposal facilities of dangerous wastes generated at Hanford Reservation for the 1990 calendar year. (KJD)

14255 (DOE/RL–91-06-Vol.3-Pt.2) **Hanford Site annual dangerous waste report: Volume 3, Part 2: Waste management facility report, Dangerous waste: Calendar year 1990.** USDOE Richland Operations Office, WA (USA); Westinghouse Hanford Co., Richland, WA (USA). [1990]. 331p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91010845. Source: OSTI; NTIS; GPO Dep.

This document, Volume 3, Part 2, contains information for the treatment, storage, and disposal facilities of dangerous wastes generated at Hanford Reservation for the 1990 calendar year. (KJD)

14256 (DOE/RL–91-06-Vol.4) **Hanford Site annual dangerous waste report: Volume 4, Waste management facility report, Radioactive mixed waste: Calendar year 1990.** USDOE Richland Operations Office, WA (USA); Westinghouse Hanford Co., Richland, WA (USA). [1990]. 203p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91010846. Source: OSTI; NTIS; GPO Dep.

This document, Volume 4, contains information for the treatment, storage, and disposal facilities of dangerous wastes generated at Hanford Reservation for the 1990 calendar year. (KJD)

14257 (DOE/WIPP–91-012-Vol.2) **Geotechnical Field Data and Analysis Report, July 1989–June 1990: Volume 2.** Westinghouse Electric Corp., Carlsbad, NM (USA). Waste Isolation Div. Mar 1991. 450p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-86AL31950. Order Number DE91009978. Source: OSTI; NTIS; INIS; GPO Dep.

The Geotechnical Field Data and Analysis Report presents the data for the assessment of the geotechnical status of the Waste Isolation Pilot Plant (WIPP). During the period of shaft sinking and construction of the principal underground access and experimental areas, reporting was on a quarterly basis. Since 1987, reporting has been carried out annually because excavation of the waste storage panels will take place more slowly and over an extended period. This report presents the data collected up to June 30, 1990. The report focuses on the presentation of geotechnical data from the various underground facilities including the shafts, shaft stations, access drifts, test rooms, and waste storage areas. It also describes the techniques used to acquire the data and the performance history of the instruments. 371 figs., 9 tabs.

14258 (DP-MS–86-217-Al-All) **Control of radioactive waste-glass melters: Parts 1 and 2.** Bickford, D.F. (Savannah River Lab., Aiken, SC (USA)); Smith, P.K.; Hrma, P.; Bowan, B.W. Savannah River Lab., Aiken, SC (USA). 12 Oct 1987. 54p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-76SR00001 ;AC09-89SR18035 ;AC07-81NE44139. (CONF-870422–15: 89. annual meeting of the American Ceramic Society, Pittsburgh, PA (USA), 26-30 Apr 1987). Order Number DE91009339. Source: OSTI; NTIS; INIS: GPO Dep.

Radioactive waste-glass melters require physical control limits and redox control of glass to assure continuous operation, and maximize production rates. Typical waste-glass melter operating conditions, and waste-glass chemical reaction paths are discussed. Glass composition, batching and melter temperature control are used to avoid the information of phases which are disruptive to melting or reduce melter life. The necessity and probable limitations of control for electric melters with complex waste feed compositions are discussed. Preliminary control limits, their bases, and alternative control methods are described for use in the Defense Waste Processing Facility (DWPF) at the US Department of Energy's Savannah River Plant (SRP), and at the West Valley Demonstration Project (WVDP). Slurries of simulated high level radioactive waste and ground glass frit or glass formers have been isothermally reacted and analyzed to identify the sequence of the major chemical reactions in waste vitrification, and their effect on waste-glass production rates. Relatively high melting rates of waste batches containing mixtures of reducing agents (formic acid, sucrose) and nitrates are attributable to exothermic reactions which occur at critical stages in the vitrification process. The effect of foaming on waste glass production rates is analyzed, and limits defined for existing waste-glass melters, based upon measurable thermophysical properties. Through balancing the high nitrate wastes of the WVDP with reducing agents, the high glass melting rates and sustained melting without foaming required for successful WVDP operations have been demonstrated. 65 refs., 4 figs., 15 tabs.

14259 (ECN-C–90-1) **Progress report of the ECN contribution to the experiments in the HAW project, 4th quarter 1989.** Duijves, K.A.; Vonka, V. Netherlands Energy Research Foundation, Petten (Netherlands). Feb 1990. 20p. Contract F1-1W-0003-D(B). Order Number DE91625099. Source: OSTI; NTIS (US Sales Only); INIS.

HAW = High-level radioactive waste.

This progress report documents the progress of the ECN contribution in the High Active Waste experiment, a large-scale in situ test being performed underground in the Asse salt mine, Remlingen FRG, during the period October 1 through December 31, 1989. (H.W.). 3 refs.; 10 figs.

14260 (ECN-C–90-2) **Progress report of the 600 m borehole project of the CEC programme on radioactive waste management and disposal, July 1989-December 1989.** Seuren, J.R. van; Benneker, P.B.J.M.; Hamilton, L.F.M.; Jockwer, N.; Prij, J. Netherlands Energy Research Foundation, Petten (Netherlands). Mar 1990. 54p. Contract F11W1/0084. Order Number DE91625100. Source: OSTI; NTIS (US Sales Only); INIS.

In the programme on radioactive waste of the Commission of the European Communities, for the period from 1985-1990, in situ experiments in salt deposits are conducted. The experiments in boreholes of 600 m depth take place in the Asse-2 saltmine in West Germany. The progress of work during the second half of 1989 is reported. For the drilling of the boreholes a new technique had to be developed. The drilling resulted in two boreholes to a depth of approximately 300 m. In one of the holes drilling will not continue and experiments have started. In the other hole the drilling will continue after major modifications and repair of the drilling rig. A second set of experiments are in preparation. These in situ experiments are conducted to validate analytical techniques for prediction of salt behavior. These techniques have previously been based on laboratory experiments. (author). 10 refs.; 16 figs.; 4 tabs.

14261 (ECN-C–90-036) **Progress report of the ECN contribution to the experiments in the HAW project, 1st quarter 1990.** Duijves, K.A.; Vonka, V. Netherlands Energy Research Foundation, Petten (Netherlands). Aug 1990. 21p. Contract FI-1W-0003-D(B). Order Number DE91625098. Source: OSTI; NTIS (US Sales Only); INIS.

This progress report documents the progress of the ECN contribution in the High Active Waste experiment, a large-scale in situ test being performed underground in the Asse salt mine, Remlingen FRG, during the period January 1 through March 31, 1990. (H.W.). 3 refs.; 10 figs.

14262 (EGG-M–89348) **Results of field testing of waste forms using lysimeters.** McConnell, J.W. Jr.; Rogers, R.D. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 18p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-900210–58: Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education, Tucson, AZ (USA), 25 Feb - 1 mar 1990). Order Number DE91010090. Source: OSTI; NTIS; INIS; GPO Dep.

The TMI-2 [Three Mile Island Unit 2] EPICOR-II Resin/Liner Low-Level Waste Data Base Development Program, funded by the U.S. Nuclear Regulatory Commission (NRC), is obtaining information on the performance of radioactive waste in a disposal environment. Waste forms fabricated using ion-exchange resins from EPICOR-II prefilters employed in the cleanup of the Three Mile Island Nuclear Power Station are being tested to: (a) develop a low-level waste data base, and (b) obtain information on survivability of waste forms in a disposal environment. This paper updates field testing of those waste forms during FY-1989. The results of the lysimeters is

presented and the use of lysimeter data in performance assessment is discussed. 16 refs., 10 figs., 5 tabs.

14263 (EGG-M–89349) **Degradation of resins in EPICOR-II prefilters from Three Mile Island.** McConnell, J.W. Jr.; Johnson, D.A. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 16p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-900210–57: Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education, Tucson, AZ (USA), 25 Feb - 1 mar 1990). Order Number DE91010091. Source: OSTI; NTIS; INIS; GPO Dep.

The Low-Level Waste Data Base Development–EPICOR-II Resin/Liner Investigation Program funded by the US Nuclear Regulatory Commission is investigating the chemical and physical conditions of the synthetic ion exchange resins contained in several EPICOR-II prefilters. Those prefilters were used during cleanup of contaminated water from the Three Mile Island Nuclear Power Station after the March 1979 accident. This paper summarizes results and analyses of the third sampling of resins from prefilters PF-8 and -20. Results are compared with baseline data from tests performed on unirradiated resins supplied by Epicor, Inc. to determine if degradation has occurred due to the high internal radiation dose. Results also are compared with results from tests performed on resins obtained from the first and second samplings of those two prefilters. 17 refs., 4 figs., 4 tabs.

14264 (EGG-M–91103) **Plasma processing of compacted drums of simulated radioactive waste.** Geimer, R. (Science Applications International Corp., Idaho Falls, ID (USA)); Batdorf, J.; Larsen, M.M. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1991]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-910270–39: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91010071. Source: OSTI; NTIS; INIS; GPO Dep.

The charter of the Department of Energy (DOE) Office of Technology Development (OTD) is to identify and develop technologies that have potential application in the treatment of DOE wastes. One particular waste of concern within the DOE is transuranic (TRU) waste, which is generated and stored at several DOE sites. High temperature DC arc generated plasma technology is an emerging treatment method for TRU waste, and its use has the potential to provide many benefits in the management of TRU. This paper begins by discussing the need for development of a treatment process for TRU waste, and the potential benefits that a plasma waste treatment system can provide in treating TRU waste. This is followed by a discussion of the results of a project conducted for the DOE to demonstrate the effectiveness of a plasma process for treating supercompacted TRU waste. 1 fig., 1 tab.

14265 (EGG-WM–9299) **Vadose zone monitoring at the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory, 1985–1989.** McElroy, D.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). Dec 1990. 221p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. Order Number DE91010097. Source: OSTI; NTIS; INIS; GPO Dep.

Vadose zone monitoring at the Radioactive Waste Management Complex (RWMC) of the Idaho National Engineering Laboratory (INEL) was implemented under the Subsurface Investigation Program Plan. The objective of the Subsurface Investigation Program was to characterize the subsurface at the RWMC in order to measure and predict radionuclide transport. Soil moisture sensors were installed to characterize the uniformity of water entry to the surficial sediments and moisture flux in the surficial sediments and the deeper stratigraphic units. From 1985 to 1987, a network of vadose zone instruments was installed in sediments at the RWMC. The instruments included psychrometers, gypsum blocks, heat-dissipation sensors (HDSs), tensiometers, lysimeters, and neutron access tubes. These instruments were placed at depths up to 230 ft below land surface (BLS) in a heterogeneous geologic system comprised of sediments that overlie and are intercalated with basalt flows. After organic contaminants were detected in the subsurface at the RWMC in 1988, the vadose zone monitoring project was incorporated into a broader characterization effort. This report presents the analyses of the vadose zone monitoring data collected from FY-1985 to FY-1989. The performance of the instruments are compared. Matric potential ranges and trends in the surficial sediments and interbeds are discussed. Hydraulic gradients are calculated to determine the direction of moisture movement. Using the neutron logging data in conjunction with the matric potential and hydraulic gradient data, infiltration is examined with respect to seasonal nature and source. 14 refs., 19 figs., 4 tabs.

14266 (HW–81868) **Chemical Processing Department Hazards Evaluation Task Force report: Americium Recovery Facility – Z Plant, Phase 1.** Braden, D.E.; Brown, C.L.; Judson, B.F.; Nilsen, C.W. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 30 Apr 1964. 31p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009598. Source: OSTI; NTIS; GPO Dep.

The Americium Recovery Facility will provide capability for the separation, concentration, purification, and conversion to oxide powder, of americium (Am-241) from the Waste Treatment Facility solvent extraction column waste stream; the latter stream will contain essentially all the americium in the plutonium scrap feed to the Plutonium Reclamation Facility. The Plutonium Reclamation Facility and Waste Treatment Facility are scheduled for operation before completion of the entire subject facility; all americium in the plutonium scrap processed during this interim period will be irretrievably lost unless at least a portion of the subject facility has been installed. Accordingly, facilities for the separation, concentration, and storage of the americium as nitrate solution will be completed at an early date; these facilities have been designated as Phase I. In March 1964, a task force was formed to review and evaluate the hazards associated with the operation of the facility. This document presents the results of the review and evaluation of the Phase I facilities only. 3 refs.

14267 (IAEA-TECDOC–588) **Inventory of radioactive material entering the marine environment: Sea disposal of radioactive waste.** International Atomic Energy Agency, Vienna (Austria). Mar 1991. 54p. Order Number DE91625104. Source: OSTI; NTIS (US Sales Only); INIS.

Variable amounts of packaged low level radioactive waste have been disposed at more than 50 sites in the northern parts of the Atlantic and Pacific Oceans. The last known disposal operation was in 1982, at a site about 550 km off the European continental shelf in the Atlantic Ocean. Since 1957, the IAEA has provided specific guidance and recommendations for ensuring that disposal of radioactive wastes into the sea will not result in unacceptable hazards to human health and marine organisms, damage to amenities or interference with other legitimate uses of the sea. In 1972, the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter designated the IAEA as the competent international authority in matters related to sea disposal of radioactive waste. The Contracting Parties requested the IAEA to develop an inventory of radioactive wastes entering the marine environment from all sources as an information base with which the impact of radioactive materials from disposal operations can be more adequately assessed. The continuous compilation of these data could ensure that the IAEA recommendations on the disposal rate in a single basin are not overstepped. The inventory shows that between 1946 to 1982 an estimated 46 PBq[1] (1.24 MCi) of radioactive waste coming from research, medicine, the nuclear industry and military activities were packaged, usually in metal drums lined with a concrete or bitumen matrix, and disposed of at sea. This inventory includes some unpackaged wastes and liquid wastes which were disposed of from 1950 to 1960. Beta-gamma emitters represent more than 98% of the total radioactivity of the waste and tritium alone represents one third of the total radioactivity disposed at the North East Atlantic sites. The other beta-gamma emitters radionuclides include ^{90}Sr, ^{137}Cs, ^{55}Fe, ^{58}Co, ^{60}Co, ^{125}I and ^{14}C. (Abstract Truncated)

14268 (IAEA-WMRA–20) **Waste management research abstracts. No. 20: Information on radioactive waste programmes in progress.** International Atomic Energy Agency, Vienna (Austria). Oct 1990. 497p. Order Number DE91625089. Source: OSTI; NTIS (US Sales Only); INIS.

The 20th issue of this publication contains over 700 abstracts from 32 IAEA Member Countries comprehending various aspects

of radioactive waste management. Radioactive waste disposal, processing and storage, geochemical and geological investigations related to waste management, mathematical models and environmental impacts are reviewed. Many programs involve cooperation among several countries and further international cooperation is expected to be promoted through availability of compiled information on research programs, institutions and scientists engaged in waste management.

14269 (INIS-mf–12187) **Systems analysis - combined concept. Final report. Abridged version.** Papp, R. (comp.). Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projektgruppe Andere Entsorgungstechniken (PAE); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Apr 1990 47p. (In German). Contract BMFT KWA 2190 A1. Order Number DE91768990. Source: OSTI; NTIS (US Sales Only); INIS.

The system appraisal, ranging from the conditioning of fuel elements and waste for reprocessing to their ultimate storage, includes methods from the dropped plans for Wackersdorf Reprocessing Plant (WAW) and the pilot conditioning plant in Gorleben (PKA) together with the interim basic planning principles for the planned Gorleben final repository among the reference systems upon which it is based. However, the study also takes account of input from development trends to include, for instance, methods of waste conditioning that were not yet a part of the WAW concept. The waste disposal system considered in the study is characterised in terms of plant throughput by the quantities laid down in 1985 i.e. 700 tonnes p.a. burn up LWR fuel and one million HTR fuel elements p.a. based on the preceding study for the LWR figures, whereas the expected waste disposal capacity for HTR was oriented towards the Juelich Nuclear Research Centre (KFA) project, taking account of the Project Steering Committee's wishes. (orig.).

14270 (INIS-mf–12806, pp. 150-158) **Nuclear waste disposal in the Pacific basin: Geology overview.** Murano, T. (Power Reactor and Nuclear Fuel Development Corp., Tokyo (Japan)); Kimura, T. Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The Pacific Basin is characterized by the widespread presence of young mobile belts. Volcanism, geothermal activity, earthquakes, faults, and fractured rocks cause problems for the siting of high-level nuclear waste disposal facilities in these young mobile belts. The authors survey the geology of the Pacific Basin region, concluding that the problems of underground waste disposal can be solved with further research.

14271 (INIS-mf–12806, pp. 159-165) **Review of science and technology for land-based geologic disposal of radioactive wastes.** Lyon, R.B. (Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment); Rosinger, E.L.J. Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

This paper reviews the science and technology available for land-based disposal of nuclear fuel waste, that is, used fuel and fuel recycle waste. Studies underway in several countries can be grouped into three categories: natural barriers provided by geological formations; engineered barriers, consisting of stable waste form, containers, backfill and shaft seals; and the demonstration of the safety of disposal concepts, both direct and indirect.

14272 (INIS-mf–12806, pp. 166-182) **Review of science and technology for disposal of low-level waste on the seabed and high-level waste in the sub-seabed.** Anderson, D.R. (Sandia National Labs., Albuquerque, NM (USA)); Boyer, D.G.; Hollister, C.D. Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The technology exists for the safe disposal of low-level radioactive wastes onto the sea floor. For over 30 years certain types of packaged low-level waste have been dumped into the ocean. During this time, national and international agencies issued guidelines to ensure that dumping operations follow environmentally sound procedures. To supplement these and provide for continuing research, member nations of the NEA established the Research and Environmental Surveillance Program Related to Sea Disposal of Radioactive Waste. Japan has studied the feasibility of dumping packaged low-level waste onto the ocean floor. Their tests indicate that dumping introduces a negligible amount of radioactivity into the ocean. Radioactive soil and defueled nuclear submarines may also be disposed of in the ocean. Research also addresses the question of disposing of high-level waste in the oceans. Swedish nuclear reactor owners plan to dispose of all types of radioactive waste in a repository excavated in granitic rock beneath the ocean. The SWG, a committee under the auspices of the Nuclear Energy Agency, is investigating the feasibility of burying properly packaged high-level waste in the sediments of the ocean floor. The group has not found any indications that buried waste would harm humans or the environment. Studies into marine disposal of radioactive waste must proceed with a commitment to the effective use of the ocean regime and the protection of its resources.

14273 (INIS-mf–12806, pp. 183-197) **Management of mine and mill tailings.** Davy, D.R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights (Australia)); Levins, D. Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

This paper describes the main wastes produced in the mining and milling of uranium ores. Waste management practice in Australia, Canada and the USA is reviewed, with an emphasis on recent trends that could reduce the overall environmental impact. Site-specific factors are shown to have more influence on waste management decisions than generalizations based on generic assessment.

14274 (INIS-mf–12807, pp. 2.7-2.17) **Industrial long term radioactive waste management in France.** Marque, Y. (Agence Nationale pour la Gestion des Dechets Radioactifs, Paris (France)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Long-term industrial management of radioactive waste in France is carried out by the Agence Nationale pour la Gestion des Dechets Radioactifs (ANDRA). ANDRA is charged with design, siting, construction and operation of disposal centers. The French national program for waste management is continuing on with the construction of a second near surface disposal which is expected to be in operation in 1991 and the selection of a site for the construction of an underground laboratory for the qualification of this site for deep disposal.

14275 (INIS-mf–12807, pp. 4.1-4.6) **Closing the circle: Returning used uranium to the geologic environment.** Hancox, W.T. (Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

The used uranium oxide fuel discharged from CANDU nuclear power reactors has physical and chemical properties similar to those of natural uranium oxide found in uranium ore bodies in the earth's crust. When discharged from the reactor, less than 1% of the initial uranium atoms have been transmuted to new radioactive atoms. The long-term hazard is associated with four exceptionally long-lived radionuclides: iodine-129, cesium-135, technetium-99

and plutonium-239. These long-lived radionuclides can do harm only if they are ingested. The only practical way for this to occur is for the uranium oxide grains to be dissolved in groundwater. Since 1978, AECL has been developing the technology to dispose of used fuel in a vault excavated, 500 m to 1,000 m beneath the surface, in plutonic rock of the Precambrian Canadian Shield. Used-fuel bundles would be sealed in corrosion-resistant containers which would be placed in clay-lined holes bored in the floor of the vault. When filled with used-fuel containers, the vault would be backfilled and sealed with a mixture of clay and crushed rock. Compelling evidence for the safety of the disposal concept is provided from recent studies of uranium ore bodies in the earth's crust, most notably at Cigar Lake. The uranium-ore body at Cigar Lake was formed about 1.3 billion years ago and, in spite of continuous contact with groundwater over this period, there has been no significant movement of uranium. Our understanding of the hydrogeology and geochemistry associated with the deposit gives us confidence that used fuel can be put back into the geological environment and isolated for its hazardous lifetime.

14276 (INIS-mf–12807, pp. 4.27-4.32) **Thermal simulation of drift emplacement for direct disposal of spent fuel: Evaluation of the backfilling technique.** Engelmann, H.J. (Deutsche Gesellschaft zum Bau und Betrieb von Endlagern fuer Abfallstoffe mbH, Peine (Germany, F.R.)); Hartje, B.; Schrimpf, C.; Wildt, K.H. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle*. Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

According to the reference concept for direct disposal of spent fuel in the FRG, large disposal casks will be emplaced onto the floor of repository drifts in salt formations. Licensing of this concept requires demonstration of a suitable backfilling technique, investigations of the behaviour of the rock salt and the backfill material. Within preceding tests two different backfilling techniques were investigated under realistic conditions: pneumatic backfilling and slinger backfilling. For the evaluation of the quality of backfill due to the technique applied, various data (in situ-density, particle size distribution, proctor density) were obtained from different areas of a simulated emplacement drift. Both backfilling techniques were evaluated considering safety, technical and economical aspects and a slinger truck was found to be most suitable for the designated purpose.

14277 (INIS-mf–12807, pp. 4.33-4.38) **Completing the cycle: Options for the back-end.** Guais, J.C. (Compagnie Generale des Matieres Nucleaires (COGEMA), 92 - Chatillon (France)); Lenail, B. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle*. Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Several criteria influence a country's decision to recycle used nuclear fuel rather than to dispose of it. These include the availability of domestic fossil fuels; competitivity of nuclear versus thermal electricity; the structure of the electricity generating organization and its financing policies; advances in nuclear technology; public acceptance and the regulatory system; long-term positive engagement in nuclear energy; the availability of domestic uranium resources; the availability of remote areas with favorable hydrogeologic conditions; and reactor type. Based on these criteria, the USA, Canada and Sweden would have little or no interest in reprocessing in the short term, while the Federal Republic of Germany, France and Japan should be engaged in recycling. The history and status of reprocessing in France is reviewed, and the recycling industry in Europe is surveyed. COGEMA's most recent calculations show only a slight cost advantage to reprocessing; therefore, non-economic considerations must decide whether a country chooses to recycle used fuel.

14278 (INIS-mf–12807, pp. 4.39-4.43) **Technical maturity of shaft hosting facilities for the 65 t-heavy casks with spent fuel.** Hartje, B. (Deutsche Gesellschaft zum Bau und Betrieb von Endlagern fuer Abfallstoffe mbH, Peine (Germany, F.R.)); Schrimpf, C.; Weber, W. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle*. Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

In a repository for spent fuel a shaft hoisting system is to be built for a transport unit (waste package and vehicle) with a total weight of 85 t. At present no suitable hoisting equipment for 85 metric tons is available anywhere in the world. To establish its technical maturity a preliminary design was carried out. More than 100 shaft hoisting facilities in operation were analyzed in a 'reference study'. The result is that nearly all main components of the shaft hoisting facility can be referred to facilities in operation. Only very few components with special requirements for a repository must be built up in a prototype scale and tested to establish its maturity.

14279 (INIS-mf–12807, pp. 4.7-4.20) **Geotechnical research at Atomic Energy of Canada Limited's underground research laboratory.** Simmons, G.R. (Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle*. Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

A dedicated research facility, the Underground Research Laboratory (URL), is being constructed by Atomic Energy of Canada Limited (AECL) in southeastern Manitoba, Canada. It is being constructed in a previously undisturbed portion of a granitic pluton that was well characterized prior to excavation. All planned testing areas are in saturated rock below the water table. The rock body containing the URL is representative of those being considered for nuclear fuel waste disposal in Canada. Therefore, the URL gives scientists and engineers an opportunity to conduct relevant research into many aspects of the waste disposal concept. It is also well suited for conducting development and demonstration tests of methods, equipment and instrumentation relevant to civil, mining and geotechnical engineering in a controlled technical environment. This paper briefly outlines the research activities taking place during development of the URL.

14280 (INIS-mf–12807, pp. 5.12-5.30) **Long-term effects of uranium tailings on Canadian surface waters.** John, R.D. (Environment Canada, Ottawa, ON (Canada). Environmental Protection Service). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle*. Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

The Federal Government established the National Uranium Tailings Program in 1982. In March 1987 the NUTP completed its five-year program. The major objective has been to provide an information base to assist government, regulatory agencies and industry to establish long-term management strategies for the protection of the environment. The most important outcome has been the development of a probabilistic, predictive model, which will allow the comparison of long-term implications of different strategies. To develop this model required a fundamental understanding of the principles involved in contaminant migration from tailings. The NUT Program was subdivided into three sections, Modelling, Measurements, and Disposal Technology. However, projects done in each of these sectors have overlapped with one another, and the Program was run as an integrated system. This paper gives an overview of the results of this program, especially the results of the first application of the mathematical system.

14281 (INIS-mf–12807, pp. 5.2-5.5) **Treatment of liquid effluents from a high grade uranium mine.** Meadley, T. (Amok Ltd., Saskatoon, SK (Canada)); Hynes, T.P. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium*

on uranium and electricity: The complete nuclear fuel cycle. Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

At its uranium mine and mill at Cluff Lake in northwestern Saskatchewan, Amok Ltd. operates water treatment systems associated with its waste management facilities. Radium concentrations in the effluent from the Cluff Lake operations have been well below the regulatory limit established by the Saskatchewan government of .37 Bq/L. Information on the company's experience in operating these treatment systems is given in this paper.

14282 (INIS-mf–12807, pp. 6.21-6.25) **Investigation program for a suitability declaration of the GORLEBEN salt dome as a repository for radioactive waste.** Gruebler, G. (Deutsche Gesellschaft zum Bau und Betrieb von Endlagern fuer Abfallstoffe mbH, Peine (Germany, F.R.)); Weg, M. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

In the Federal Republic of Germany the GORLEBEN salt dome is under investigation for its suitability as a site for the final disposal of all categories of radioactive waste. The objective is the detailed exploration of the geological and hydrogeological conditions prevailing in and around the GORLEBEN salt dome. The paper outlines the geological, hydrogeological and geomechanical investigations performed during the surface exploration. The preparatory steps of the underground program are summarized. The underground exploration will cover an area 10 km x 2 km in the central part of the salt dome at 840 m depth, and will require 25 km of drifting and 120 km of core drilling. The status of the project is described as well as the time schedule leading to a final suitability declaration within a public licensing procedure. The earliest expected date for the repository to become operational is after the year 2000.

14283 (INIS-mf–12807, pp. 7.17-7.21) **Management of low level radioactive solid waste from nuclear generating stations.** Dicke, G.J. (Ontario Hydro, Toronto, ON (Canada)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Ontario Hydro provides complete management of the radioactive waste produced at its nuclear generating stations. A brief overview will be given specifically with regard to the management of its low level radioactive solid waste. This paper presents practices and facilities as well as current considerations with regard to the future management of this waste.

14284 (INIS-mf–12807, pp. 7.1-7.8) **Canadian perspectives on the management of low-level radioactive wastes.** Chambers, D.B. (SENES Consultants Limited, Richmond Hill, ON (Canada)); Knapp, R.A.; Case, G.G. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Canada has adopted the administrative practice of classifying radioactive wastes into one of two categories: high-level, in essence spent reactor fuel; and low-level, which is everything else. However, the 'low-level' category is further divided into: 'low-level radioactive wastes', namely all forms of radioactive waste other than uranium mill tailings; uranium mill tailings; historic wastes such as those in Port Hope, Ontario or Surrey, B.C. and, of recent interest, incidental wastes where radioactivity is naturally present in the raw material. Each of these categories of 'low-level' waste have quite distinct physical and chemical characteristics and pose different hazards in the workplace and to the environment. In addition, the ways in which each of these wastes have been managed has evolved over the years in a somewhat independent fashion. At the present time there is no licensed disposal facility for low-level radioactive wastes in Canada. Indeed a recent task force questioned the concept of permanent management as an alternative. In this paper we briefly review the volume and nature of each of the various categories of low-level radioactive waste and the prospects for either permanent disposal or long-term management. In Canada, as elsewhere, the public consultative process appears fundamental to the resolution of these problems.

14285 (INIS-mf–12807, pp. 7.9-7.16) **Low activity uranium waste management: A world perspective.** Snodgrass, W.J. (Beak Consultants Ltd., Toronto, ON (Canada)); Molineri, J. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

A global perspective on the management of low activity, uranium mill wastes is developed in this paper. The perspective is developed by examining the geochemical forms of radionuclides and heavy metals in the tailings. Then the probable effect of different management factors such as site selection, tailings site design (above grade, below grade, etc.), milling process selection, geomorphological setting, geotechnical factors, waste treatment, infiltration rates, and temperature are related to these geochemical forms and the potential for radiological/toxicological risk to humans. Finally, alternative management philosophies (containment or dispersal) and their impact on management are examined. The geochemical perspective is calibrated by presentation of a few site specific examples from around the world at the conference.

14286 (INIS-XN–306) **The international intraval project to study validation of geosphere transport models for performance assessment of nuclear waste disposal: Background and results 1990.** Nuclear Energy Agency, 75 - Paris (France). 1990. 46p. Order Number DE91625105. Source: OSTI; NTIS (US Sales Only); INIS.

INTRAVAL is an international project concerned with the use of mathematical models for predicting the potential transport of radioactive substances in the geosphere. Such models are used to help assess the longterm safety of radioactive waste disposal systems. The INTRAVAL project was established to evaluate the validity of these models. Results from a set of selected laboratory and field experiments as well as studies of occurrences of radioactive substances in nature (natural analogues) are compared in a systematic way with model predictions. Discrepancies between observations and predictions are discussed and analyzed.

14287 (JAERI-M–90-208) **Electrolytic decontamination of transuranic wastes by alternating electrolysis.** Kozai, Naofumi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Moriyama, Noboru; Dojiri, Shigeru. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 20p. (In Japanese). Order Number DE91767877. Source: OSTI; NTIS (US Sales Only); INIS.

Experiments were carried out on the applicability of alternating electrolysis for decontamination of metallic wastes contaminated with transuranic nuclides. Carbon steel and stainless steel were used as simulated metal wastes for present study. Samples of carbon steel which had no oxide layer and stainless steel were decontaminated effectively by anodic electrolysis. Carbon steel samples with oxide layer was easily removed by alternating electrolysis and decontaminated in a short time. In acid electrolytes such as sulfuric acid, all samples were decontaminated more easily than in neutral salt electrolytes. On the other hand, in the neutral salt electrolytes, dissolved metals and plutonium precipitate as hydroxy metals which can be easily separated from electrolytes. (author).

14288 (Juel–2401) **The radiolytic formation of hydrogen in cement specimens homogeneously doped with dissolver sludge.** Kroth, K.; Lammertz, H. Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Chemische Technologie. Nov 1990. 48p. (In German). Contract BMFT KWA 5302 B6. Order Number DE91764960. Source: OSTI; NTIS (US Sales Only); INIS.

The radiolytic formation of hydrogen in cement specimens doped with dissolver sludge was found to be by a factor of 10-100 less than was expected on the basis of their measured nuclear inventory and a G_{H2}-value of 0.45 $ml_{STP}/10^6$ Gy.g. The radiolytic

formation of hydrogen was found to be suppressed by a combination of the two following reaction mechanisms: Large amounts of hydrogen are chemically bound by hydrogenation of metallic dissolver sludge phases. Dissolver sludge exhibits catalytic features. In the presence of dissolver sludge, hydrogen is oxidyzed to water as long as sufficient oxygen is available. As a result of our experimental study, only unimportant amounts of hydrogen are expected to be released from real waste packages with homogeneously cemented dissolver sludge. (orig.).

14289 (K/QT–394-Pt.1) **Evaluation of alternatives for best available technology treatment and retreatment of uranium-contaminated wastewater at the Paducah Gaseous Diffusion Plant C-400 Facility.** Del Cul, G.D.; Osborne, P.E.; Beck, D.E. Oak Ridge K-25 Site, TN (USA). Jan 1991. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OT21400. Order Number DE91009877. Source: OSTI; NTIS; INIS; GPO Dep.

The Paducah Gaseous Diffusion Plant (PGDP) C-400 Decontamination Facility generates aqueous solutions that originate in drum washing, machine parts and equipment cleaning, and other decontamination processes. The chemical composition of the waste depends on the particular operation involved. In general, the waste contains uranyl, fluoride, carbonate, and nitrate ions, plus soaps, detergents, secondary contaminants, and particulate matter. The uranium content is rather variable ranging between 0.5 and 30 g/l. The main contaminants are fluoride, technetium, uranium, and other heavy metals. The plan included (1) a literature search to support best available technology (BAT) evaluation of treatment alternatives, (2) a quality assurance/quality control plan, (3) suggestion of alternative treatment options, (4) bench-scale tests studies of the proposed treatment alternatives, and (5) establishment of the final recommendation. The following report records the evaluation of items (1) to (3) of the action plan for the BAT evaluation of alternatives for the treatment and retreatment of uranium-contaminated wastewater at the PGDP C-400 treatment facility. After a thorough literature search, five major technologies were considered: (1) precipitation/coprecipitation, (2) reverse osmosis, (3) ultrafiltration, (4) supported liquid membranes, and (5) ion exchange. Biosorption was also considered, but as it is a fairly new technology with few demonstrations of its capabilities, it is mentioned only briefly in the report. Based on C-400's requirements and facilities, the precipitation/coprecipitation process appears to be the best suited for use at the plant. Four different treatment options using the precipitation/coprecipitation technology are proposed. Bench-scale studies of the four options are suggested. 37 refs.

14290 (LA-UR–91-100) **Accelerator technology for the Los Alamos ATW [accelerator transmutation of nuclear waste] system.** Lawrence, G.P. Los Alamos National Lab., NM (USA). [1991]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910603–4: Annual meeting of the American Nuclear Society (ANS), Orlando, FL (USA), 2-6 Jun 1991). Order Number DE91007356. Source: OSTI; NTIS; INIS; GPO Dep.

The Los Alamos concept for accelerator transmutation of nuclear waste (ATW) employs a high-power proton linear accelerator to generate intense fluxes of thermal neutrons ($>10^{16}$ n/cm^2-s) through spallation on a lead-bismuth target. The nominal beam energy for an ATW accelerator is 1.6 GeV, with average current requirements ranging from 250 mA to 30 mA, depending on application specifics. A recent study of accelerator production of tritium (APT) led to the development of a detailed point design for a 1.6 GeV, 250 mA cw proton linac. The accelerator design was reviewed by the Energy Research Advisory Board (ERAB) and found to be technically sound. The Panel concluded that linac of this power level could now be implemented within the existing technology base, given an adequate component development program and an integrated engineering demonstration of the front end.

14291 (LA-UR–91-148) **Transmutation calculations for the accelerator transmutation of waste (ATW) program.** Wilson, W.B.; Arthur, E.D.; Bowman, C.D.; Engel, L.N.; England, T.R.; Hughes, H.G.; Lisowski, P.W.; Perry, R.T. Los Alamos National Lab., NM (USA). [1991]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910603–6: Annual meeting of the American Nuclear Society (ANS), Orlando, FL (USA), 2-6 Jun 1991). Order Number DE91007392. Source: OSTI; NTIS; INIS; GPO Dep.

The disposal of radioactive waste by the transmutation of long-lived radionuclides is being considered; now using neutrons produced with an intense beam of 1.6-GeV protons on a Pb-Bi target. Study teams have been active in the areas of accelerator design, beam transport, radiation transport, transmutation, fluid flow and heat transfer, process chemistry and system analyses. Work is of a preliminary and developmental nature. Here we describe these preliminary efforts in transmutation calculations; the tools developed, status of basic nuclear data, and some early results. These calculations require the description of the intensity and spectrum of neutrons produced by the beam, the distribution of nuclides produced in the medium-energy reactions, the transport of particles produced by the beam, the transmutation of the target materials and transmutation products, and the decay properties of the inventory of radionuclides produced.

14292 (LA-UR–91-155) **Monte Carlo simulations of models for accelerator transmutation of waste.** Hughes, H.G.; Engel, L.N. Los Alamos National Lab., NM (USA). [1991]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910603–5: Annual meeting of the American Nuclear Society (ANS), Orlando, FL (USA), 2-6 Jun 1991). Order Number DE91007393. Source: OSTI; NTIS; INIS; GPO Dep.

The Los Alamos Accelerator Transmutation of Waste (ATW) program is directed toward the dual goals of alleviating the problems associated with existing high-level radioactive defense wastes, and of developing systems for the generation of fission energy with minimal production of high-level, long-lived nuclear wastes. In the Los Alamos ATW concept, a high-current, high-energy proton accelerator creates and intense flux of neutrons through spallation in heavy metal targets. The high neutron flux levels available in such systems allow the rapid burning even of nuclides with small cross sections, the design of systems with dilute inventories, and the operation of systems far from criticality. A crucial tool for ATW simulations is the LAHET Code System (LCS), which consists of the Los Alamos version of the HETC Monte Carlo code, a special version of the MCNP code, and several tallying and postprocessing utilities. Here we present results for a baseline system designed to transmute technetium. 16 refs.

14293 (LA-UR–91-907) **A novel device for processing radioactive combustibles.** Phelan, P.F. (Los Alamos National Lab., NM (USA)); Thompson, T.K. Los Alamos National Lab., NM (USA). [1991]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910559–1: 10. annual international incineration conference: environmental concerns and controls, Knoxville, TN (USA), 13-17 May 1991). Order Number DE91009958. Source: OSTI; NTIS; INIS; GPO Dep.

Los Alamos National Laboratory is assisting EG&G Rocky Flats, Colorado, with the development of a special incinerator for wastes contaminated with plutonium, a radioactive element. This paper describes one conceptual design that was developed by T.K. Thompson, Inc., under contract to Los Alamos National Laboratory. The design is a tentative proposal that tries to address the many constraints that are peculiar to this project. It has not been endorsed or accepted by EG&G Rocky Flats, and it is subject to revision. Nevertheless, it is noteworthy because of the novel concepts it embodies. Before examining the design itself, it is instructive to understand the constraints imposed by safety and operational concerns. There are three main requirements related to safety: There may be no emissions of radioactive material either to the atmosphere or into the building that houses the incinerator. The outer surfaces of the combustion chamber must be kept below 140oF so that the lead-lined rubber gloves will not melt if the operator reaches inside the glovebox while the incinerator is hot. The combustion chambers and other locations where plutonium-containing ash could accumulate must be designed in such a way that it would be impossible for a critically accident to occur. 3 figs.

14294 (NSS/G–113) **Radionuclide transport by groundwater flow through the geosphere: current status 1989.** Lever, D.A. (AEA Decommissioning and Radwaste, Harwell (UK). Radwaste Disposal Research and Development); Woodwark, D.R. United Kingdom Nirex Ltd., Harwell (UK). May 1990. 71p. (AEA-D

and R–0012.). Order Number DE91624469. Source: OSTI; NTIS (US Sales Only); INIS.

The geosphere is an important barrier retaining radionuclides that have been released from the near field of a waste repository and retarding their return to Man. The assessment models used in the current Nirex assessments to described the groundwater flow in the vicinity of the repository and the transport of radionuclides by that groundwater are summarized, and their data requirements are set out. The associated research programme is also outlined. This research forms part of the Nirex Safety Assessment Research Programme, which is designed to provide improved and additional data for these models, to deepen the understanding of the important processes and to develop improved models to describe them. This document outlines the status of the assessment models and associated research programme in the Spring of 1989. The programme complements existing knowledge in this field. Key areas are measurements of the physical properties of rocks, field and modelling studies of fractured rocks, measurements of sorption onto geological materials, investigation of the possible importance of colloid transport and inhomogeneities in rock characteristics, transport of naturally occurring elements over geological timescales in natural geochemical systems, and participation in an international model validation exercise. (author).

14295 (NSS-R–146) **Migration of gases through argillaceous rocks: A literature review.** Tomlinson, M.J. (Exeter Univ. (UK). Dept. of Geology). United Kingdom Nirex Ltd., Harwell (UK). Nov 1988. 151p. Order Number DE91625106. Source: OSTI; NTIS (US Sales Only); INIS.

Research literature relating to laboratory and field experimentation and numerical modelling of gas transport in argillaceous geological materials has been examined. A data base has been formed to assist simulation of gas migration behaviour from proposed underground nuclear waste repositories. (author).

14296 (NSS/R–147) **Migration of gases through fractured argillaceous rocks: experimental work at the Reskajeage Farm Quarry site, Cornwall.** Elliot, T. (Cambridge Univ. (UK). Dept. of Earth Sciences); Tomlinson, M.J.; Holbrough, D.J.; Searle, D.M.; Foxford, K.A. United Kingdom Nirex Ltd., Harwell (UK). Mar 1989. 78p. (AEA-D and R–0030.). Order Number DE91625107. Source: OSTI; NTIS (US Sales Only); INIS.

The objective of the fieldwork in the Cornish slate site was to attempt in-situ testing of gas permeabilities of single fracture systems in the formation using a downhole packer. Complementary hydraulic studies at the same site are currently in process, conducted by B Watkins of Elcon Western (electrical) Ltd, Redruth. Two boreholes, BH2 and BH14 have been gas flow tested at depths between 9.85-13.30 m and 22.40-28.00 m, respectively, using oxygen-free nitrogen. Altogether 24 flow sections have been logged and continuously flow-tested over periods ranging from 1-10 hours. Seven of these flow sections were tested until steady-state flow conditions had been achieved, and at six of these levels rising/falling pressure tests were then conducted. Pressure decay tests have been performed at four test levels which had been logged as having little or no measurable gas flow. For both boreholes the recovered core has been fully logged for fracture and lithological variations, and the identified flow sections have been correlated with these logs. In the case of BH14, successful impression packering of fracture/vein patterns in the borehole wall from 5.01-18.02 m depth has been made. The fractures recorded in the impressions have been correlated with fractures logged in the recovered core over the same section of the borehole. (author).

14297 (NSS/R–159) **Mass transfer through clay by diffusion and advection: description of INTRAVAL Test Case 1a.** Bourke, P.J. (AEA Decommissioning and Radwaste, Harwell (UK). Radwaste Disposal Research and Development); Gilling, D.; Jefferies, N.L.; Lever, D.A.; Lineham, T.R. United Kingdom Nirex Ltd., Harwell (UK). May 1990. 67p. (AEA-D and R–0015.). Order Number DE91625108. Source: OSTI; NTIS (US Sales Only); INIS.

UK Nirex Ltd is planning the development of a deep geological repository for the disposal of solid low-level and intermediate-level radioactive waste. The rock surrounding such a waste repository is an important barrier restricting the return of radionuclides in the waste to Man's environment. It is important to validate the models used in Safety assessments of such a repository. The international INTRAVAL project is specifically concerned with the validation of models used to describe the transport of radionuclides through the geosphere. INTRAVAL was initiated by the Swedilsh Nuclear Power Inspectorate (SKI) in 1987. The format of the INTRAVAL project is that there are a number of test cases based on well characterized experiments. There is a mixture of laboratory and field experiments and natural analogues. In the first phase of the project there are 14 test cases. This report describes Test Case 1a, which is concerned with laboratory experiments on clay. The experimental techniques and the results of the experiments on which the INTRAVAL analysis is carried out are described. (author).

14298 (NSS/R–184) **Geology of Reskajeage Farm Quarry (Nirex research site on Cornish slate).** Hancock, P.L. (Bristol Univ. (UK). Dept. of Geology); North, C.P. United Kingdom Nirex Ltd., Harwell (UK). Aug 1989. 35p. Order Number DE91625109. Source: OSTI; NTIS (US Sales Only); INIS.

Convection with any water flow is the most likely way in which any radionuclides escaping from deep disposal of radioactive waste in hard fractured rock could return to the surface. Hence the interest in water flow and mass transport through fractures for establishing the safety of such disposal. Earlier work on this subject was carried out in granite at Troon in Cornwall. This work provided statistical data about individual fractures and helped with the development of realistic modelling of flow and transport (Bourke 1985 and 1988). Validation of this modelling was however impractical. Access was obtained to another site with a much smaller separation between fractures in slate to allow measurement of flow and transport through representative volumes of 10m dimensions. Individual fracture statistics are being determined so that modelling predictions can be theoretically made for experimental proving. The programme at the site was begun with a geological investigation. The main findings are that the somewhat heterogeneous hard rock consists mostly of siltstone with some sandstone layers, that it is not untypically broken by many fractures and that a comparatively major (3m wide) fault with slip of about a metre between its faces crossing part of the site. These findings are described in detail in the report. (author).

14299 (NVS-P–11) **Collecting, processing, storage and disposal of wastes containing radioactivity.** Rosendaal, J. (Nederlandse Vereniging voor Stralingshygiene, Eindhoven (Netherlands)); Angenent, F.; Dignum, P.H. DGMH/HIMH-NVS Collaboration. Nederlandse Vereniging voor Stralingshygiene, Eindhoven (Netherlands). Jan 1990. 35p. (In Dutch). Projectnr. 711.0.2.4-01/B.15. Order Number DE91625090. Source: OSTI; NTIS (US Sales Only); INIS.

This publication is in nature a set of recommendations towards in practice working radiation protection specialists who are involved within their company or institute with the care for radioactive waste. It may be applied in the use of radioactive materials in industry, hospitals, research institutes and universities and is not intended for 'high-level nuclear waste' from nuclear powerplants. After a foreword and an introduction it is lined out what is understood in this publication with radioactive waste in ch.3. Ch. 4 discusses when it is a question of radioactive waste. Ch. 5 reflects in which way one can get rid of wastes which contain radioactive materials and discusses when and in which way a waste planning has to be made. Ch. 6 enters into the separation of the various species of waste. Ch. 7 presents rules for collecting of waste at the work station, while ch. 8 discusses the temporary storage of waste containing radioactive materials. The final chapter presents indications for the transport within and outside the institute. (author). 11 refs.; 14 figs.; 3 tabs.

14300 (ORNL/TM–11780) **Waste reduction program at Oak Ridge National Laboratory during CY 1990.** Homan, M.D. (PAI Corp., Oak Ridge, TN (USA)); Kendrick, C.M.; Schultz, R.M. Oak Ridge National Lab., TN (USA). Mar 1991. 38p. Sponsored by US-DOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91009632. Source: OSTI; NTIS; INIS; GPO Dep.

Oak Ridge National Laboratory is a multipurpose research and development facility owned and operated by the Department of Energy and managed under subcontract by Martin Marietta Energy

Systems, Inc. ORNL's primary role is the support of energy technology through applied research and engineering development and scientific research in basic and physical sciences. ORNL also is a valuable resource in the quest to solve problems of national importance, such as nuclear and chemical waste management. In addition, ORNL produces useful radioactive and stable isotopes for medical and energy research that are unavailable from the private sector. These activities are conducted predominantly on small scales in over 900 individual R&D laboratories at ORNL. Activities are diverse, variable, and frequently generate some type of waste material. In contrast to the typical production facility's few large-volume waste "streams," ORNL has numerous small ones, including radioactive LLLW, liquid PW, solid radioactive waste (LLW and TRU waste), hazardous waste, industrial waste, and mixed waste (containing both hazardous and radioactive constituents). The wide diversity of waste complicates both management and compliance with reporting requirements that are designed to apply to production facilities. The reduction of all ORNL waste generation is an economically logical response to the rising costs and liabilities of waste management and disposal. Human health and the environment are best protected from all types of wastes by prevention of their generation from the start. At ORNL, efforts to minimize many wastes have been mandated by federal regulations and DOE, Energy Systems, and internal policies. Real progress has been achieved. As researchers become increasingly aware of the advantages of improving the efficiency of their procedures and as divisions launch systematic evaluations of activities with reduction potential, further reductions will be achieved. 24 refs., 8 figs., 9 tabs.

14301 (ORS–1987-1) **Advantages of separation of high-level nuclear waste into two waste categories.** Broek, W.M.G.T. van den (Technische Universiteit Delft (Netherlands). Faculty of Mining and Petroleum Engineering, Laboratory of Petroleum Engineering and Technical Geophysics). Technische Univ. Delft (Netherlands). Lab. of Petroleum Engineering and Technical Geophysics. Oct 1987. 35p. Order Number DE91626127. Source: OSTI; NTIS (US Sales Only); INIS.

High-level nuclear waste (HLW) contains two groups of radioactive nuclides with very different characteristics: 1. the 'heat generators' which produce heat during a few hundred years and 2. the long-living radioactive nuclides, especially the 'transuranes', which remain radioactive for a very long time with practically no heat production. The presence of each group leads to special demands for waste disposal. Separation of the HLW into two waste categories, a heat generators category and a transuranes category, may lead to a simpler, safer and more efficient disposal of the waste. A first analysis of separation of HLW into two waste categories is presented. This analysis is based on relative toxic risks: both radiotoxicity and chemical toxicity are taken into account. Four separation schemes have been considered. In connection with chemical separation aspects a favourable separation scheme proved to be the scheme where the transuranes category contains the actinides and the (non-radioactive) lanthanides and the heat generators category the rest of the HLW. (author). 16 refs.; 6 figs.; 8 tabs.

14302 (PNL–7520) **A survey of available information on gas generation in tank 241-SY-101: Hanford Tank Safety Project.** Strachan, D.M. (comp.) (Pacific Northwest Lab., Richland, WA (USA)); Reynolds, D.A.; Siemer, D.D.; Wallace, R.W. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009680. Source: OSTI; NTIS; INIS; GPO Dep.

As a result of a concerted effort to determine the chemical and physical mechanisms underlying the generation and episodic release of gases from tank 241-SY-101, more commonly known as tank 101-SY, the Tank Waste Science Panel has been established at the Pacific Northwest Laboratory. Four of the members of this panel met to screen the available information on tank 101-SY and provide to the remaining members a shortened list of references that could be used to assess the mechanisms underlying the generation and episodic release of gases from tank 101-SY. This document is the result of this preliminary screening of information for the Tank Waste Science Panel and was provided to the Panel members at their first meeting. 14 refs., 3 tabs.

14303 (PNL–7562) **Simulation of unsaturated flow and solute transport at the Las Cruces trench site using the PORFLO-3 computer code.** Rockhold, M.L.; Wurstner, S.K. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 54p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009730. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of this work was to test the ability of the PORFLO-3 computer code to simulate water infiltration and solute transport in dry soils. Data from a field-scale unsaturated zone flow and transport experiment, conducted near Las Cruces, New Mexico, were used for model validation. A spatial moment analysis was used to provide a quantitative basis for comparing the mean simulated and observed flow behavior. The scope of this work was limited to two-dimensional simulations of the second experiment at the Las Cruces trench site. Three simulation cases are presented. The first case represents a uniform soil profile, with homogeneous, isotropic hydraulic and transport properties. The second and third cases represent single stochastic realizations of randomly heterogeneous hydraulic conductivity fields, generated from the cumulative probability distribution of the measured data. Two-dimensional simulations produced water content changes that matched the observed data reasonably well. Models that explicitly incorporated heterogeneous hydraulic conductivity fields reproduced the characteristics of the observed data somewhat better than a uniform, homogeneous model. Improved predictions of water content changes at specific spatial locations were obtained by adjusting the soil hydraulic properties. The results of this study should only be considered a qualitative validation of the PORFLO-3 code. However, the results of this study demonstrate the importance of site-specific data for model calibration. Applications of the code for waste management and remediation activities will require site-specific data for model calibration before defensible predictions of unsaturated flow and containment transport can be made. 23 refs., 16 figs., 3 tabs.

14304 (PNL–7595) **Chemical and physical processes in Tank 241-SY-101: A preliminary report: Hanford Tank Safety Project.** Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 38p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009369. Source: OSTI; NTIS; INIS; GPO Dep.

Since 1942, chemical and radioactive waste have been stored in underground tanks at the Hanford Site. In March 1981 one of the double shell tanks, 241-SY-101 (called 101-SY), began venting large quantities of gas, primarily hydrogen and nitrous oxide. Because of the potential for explosion Westinghouse Hanford Company and the US Department of Energy realized the need for knowledge about the processes occurring in this tank that lead to generation of the gases. In June 1990, the Pacific Northwest Laboratory began assembling a Tank Waste Science Panel to develop a better understanding of the processes occurring the Tank 101-SY. This knowledge is necessary to provide a technically defensible basis for the safety analyses, which will allow the tank contents to be sampled, as well as for the future remediation of the tank and its contents. The Panel concluded that the data available on Tank 101-SY are insufficient to allow the critical chemical and physical processes giving rise to gas formation and release to be unambiguously identified. To provide the needed information the Panel recommends that Tank 101-SY by physically and chemically characterized as fully as possible and as expeditiously as safety considerations allow, and laboratory studies and modeling efforts be undertaken the chemical and physical processes involved in gas generation and release. Finally, the Panel recommends that no remediation steps be taken until there is a better understanding of the chemical and physical phenomena occurring in Tank 101-SY. Premature remediation steps may only serve to compound the problem. Furthermore, such steps may change the chemical and physical characteristics of the tank and prevent a true understanding of the phenomena involved. As a consequence, similar problems in other tanks on the site may not be adequately addressed. 17 refs., 3 figs., 1 tab.

14305 (PNL–7598) **Minutes of the Tank Waste Science Panel meeting, July 20, 1990: Hanford Tank Safety Project.** Strachan, D.M.; Morgan, L.G. (comps.). Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 35p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009370. Source: OSTI; NTIS; INIS; GPO Dep.

The second meeting of the Tank Waste Science Panel was held July 20, 1990. Science Panel members discussed the prioritization of various analyses to be performed on core samples from tank 101-SY, and were asked to review and comment on the draft Westinghouse Hanford Company document "Analytical Chemistry Plan." They also reviewed and discussed the initial contributions to the report titled Chemical and Physical Processes in Tank 101-SY: A Preliminary Report. Science Panel members agreed that a fundamental understanding of the physical and chemical processes in the tank is essential, and strongly recommended that no remediation measures be taken until there is a better understanding of the chemical and physical phenomena that result in the episodic gas release from tank 101-SY. 1 ref.

14306 (SAND–87-2381) **Analysis of component surface/downhole ground motions at Yucca Mountain for underground nuclear explosions in Pahute Mesa.** Phillips, J.S. Sandia National Labs., Albuquerque, NM (USA). Mar 1991. 189p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009820. Source: OSTI; NTIS; INIS; GPO Dep.

The Weapons Test Seismic Investigations (WTSI) project has been working in support of the Yucca Mountain Site Characterization Project (YMP) since 1977. If a waste storage facility is located near the Nevada Test Site (NTS) it will be subjected to ground shaking generated by underground nuclear weapons tests. A knowledge of expected ground motion levels from these tests will enable the designers to provide for the necessary structural support in the designs of the various components of the repository. The primary mission of the WTSI project involves recording and analyzing ground motion data from these underground nuclear explosions (UNEs) and developing a method to predict the amplitude of ground motions generated at the repository site from future weapons tests. Surface and downhole ground motion data have been recorded at Yucca Mountain stations. Peak amplitudes as well as pseudo-relative velocity response spectra (PSRVs) for these data are studied. Surface/downhole behavior of the ground motion is best described as an arithmetic average of the ratios of surface/downhole PSRVs at each station. For the most part, downhole motions are less than surface motions. The one exception to this is station W28, where an anomalous, high frequency signal is present in the horizontal components. Possible explanations are given for this behavior. 11 refs., 28 figs., 15 tabs.

14307 (SAND–89-0592) **A constitutive model for jointed rock mass with two intersecting sets of joints.** Chen, E.P. Sandia National Labs., Albuquerque, NM (USA). Mar 1991. 29p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91010651. Source: OSTI; NTIS; INIS; GPO Dep.

This investigation involves the development of a general two-dimensional continuum model to describe jointed rock mass. Chen recently developed a model for the analysis of rock mass containing two orthogonal joint sets. Development of the orthogonal joint set model followed the general formulation of Morland and the special single joint set implementation of Morland's model by Thomas. Although the orthogonal joint set model has proven useful for analyzing field-scale problems, it remains restrictive in terms of the general field conditions. In this paper, the orthogonal joint set model has been extended to a more general model where the orthogonality restriction has been relaxed. Fundamental approaches remain the same for both models. However, as the general model becomes capable of treating physically more complicated problems, it becomes mathematically more complex. This complexity provides the potential to study more completely the interaction of various parameters representing the characteristics of jointed rock mass behavior. The equation governing the solution of the problem has been given, and example problems have been solved. The behavior of the rock mass predicted by the orthogonal joint set model has been compared to the general model. This model has been developed to aid in characterizing the site of the repository at Yucca Mountain, Nevada, for the potential geologic disposal of radioactive waste. Disposal of high-level nuclear waste is currently being considered by the Yucca Mountain Project, administered by the Nevada Operations Office of the US Department of Energy. 7 refs., 15 figs.

14308 (SAND–89-1585) **Compilation of selected marine radioecological data for the Formerly Utilized Sites Remedial Action Program: Summaries of available radioecological concentration factors and biological half-lives.** Gomez, L.S. (Sandia National Labs., Albuquerque, NM (USA)); Marietta, M.G.; Jackson, D.W. Sandia National Labs., Albuquerque, NM (USA). Feb 1991. 260p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009985. Source: OSTI; NTIS; INIS; GPO Dep.

The Formerly Utilized Sites Remedial Action Program has updated an extensive objective concentration factor and biological half-life data base from the international marine radioecological literature. A microcomputer-based data management system has been implemented to provide statistical and graphic summaries of these data. The data base is constructed in a manner which allows subsets to be sorted using a number of interstudy variables such as organism category, tissue/organ category, geographic location (for in situ studies), and several laboratory-related conditions (e.g., exposure time and exposure concentrator). This report updates earlier reviews, and provides summaries of the tabulated data. In addition to the concentration factor/biological half-life data base, we provide an outline of other published marine radioecological works. Our goal is to present these data in a form that enables those concerned with predictive assessment of radiation dose in the marine environment to make a more judicious selection of data for a given application. 588 refs., 18 figs., 3 tabs.

14309 (SAND–89-2270) **Estimates of spatial correlation in volcanic tuff, Yucca Mountain, Nevada: Yucca Mountain Site Characterization Project.** Rautman, C.A. Sandia National Labs., Albuquerque, NM (USA). Feb 1991. 116p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009184. Source: OSTI; NTIS; INIS; GPO Dep.

The spatial correlation structure of volcanic tuffs at and near the site of the proposed high-level nuclear waste repository at Yucca Mountain, Nevada, is estimated using samples obtained from surface outcrops and drill holes. Data are examined for four rock properties: porosity, air permeability, saturated hydraulic conductivity, and dry bulk density. Spatial continuity patterns are identified in both lateral and vertical (stratigraphic) dimensions. The data are examined for the Calico Hills tuff stratigraphic unit and also without regard for stratigraphy. Variogram models fitted to the sample data from the tuffs of Calico Hills indicate that porosity is correlated laterally over distances of up to 3000 feet. If air permeability and saturated conductivity values are viewed as semi-interchangeable for purposes of identifying spatial structure, the data suggest a maximum range of correlation of 300 to 500 feet without any obvious horizontal to vertical anisotropy. Continuity exists over vertical distances of roughly 200 feet. Similar variogram models fitted to sample data taken from vertical drill holes without regard for stratigraphy suggest that correlation exists over distances of 500 to 800 feet for each rock property examined. Spatial correlation of rock properties violates the sample-independence assumptions of classical statistics to a degree not usually acknowledged. In effect, the existence of spatial structure reduces the "equivalent" number of samples below the number of physical samples. This reduction in the effective sampling density has important implications for site characterization for the Yucca Mountain Project. 19 refs., 43 figs., 5 tabs.

14310 (SAND–90-0365) **Literature review of crud spallation source with application to a nuclear waste repository.** Adams, K.G. Sandia National Labs., Albuquerque, NM (USA). Dec 1990. 56p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009725. Source: OSTI; NTIS; INIS; GPO Dep.

The literature is reviewed on the amount and the characteristics of particulate material (crud), that is deposited on Light Water Reactor (LWR) fuel rods and assemblies. Currently available data on

crud composition, specific activity, spallation mechanisms, potential environmental release, and particle size distributions is considered. In addition, literature that pertains to the possible impact of crud on repository operations is surveyed. This report consists of rather extensive excerpts from the published literature on crud that may have a bearing on repository risk assessment. Commentary on the possible effects of crud on repository operations and the applicability of available crud information to repository risk analyses is included. In addition, estimates are made of the quantity of crud that might be available for release during the different phases of repository operations. Using these estimates, the total effective dose equivalent is determined at several distances from a release point. 41 refs., 32 tabs.

14311 (SAND–90-3065C) **Intelligent systems for remote decommissioning in hazardous environments.** Drotning, W.D.; Bennett, P.C. Sandia National Labs., Albuquerque, NM (USA). [1991]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910602–12: American Society of Mechanical Engineers (ASME) pressure vessels and piping conference, San Diego, CA (USA), 23-27 Jun 1991). Order Number DE91008573. Source: OSTI; NTIS; INIS; GPO Dep.

Investigation of advanced technologies utilizing intelligent machines is being supported jointly by the US Department of Energy Offices of Civilian Radioactive Waste Management (DOE/RW) and Environmental Restoration and Waste Management (DOE/EM) for automation of transportation package handling operations at nuclear facilities and of nuclear waste site remediation efforts. Handling operation requirements include identification, location, and health physics operation, followed by bolting/unbolting operations and package disassembly. To accommodate these operations and the diversity of packages, fast model-based automated programming and force feedback control of a robotic cask handling system were developed. In addition, sensor-directed model-based robotic control has been demonstrated for application to hazardous material cleanup. In this application, a graphical interface is used to simulate and evaluate operator-controlled motions and provide telerobotic control of the system. Remote automated handling technologies developed through these programs have the potential to decrease worker exposure and increase efficiency during decommissioning activities in hazardous environments. 8 refs., 4 figs.

14312 (UCID–21640) **Prototype Engineered Barrier System Field Tests (PEBSFT): Progress report through November 1, 1988.** Ramirez, A.L.; Wilder, D.G. (eds.). Lawrence Livermore National Lab., CA (USA). Feb 1991. 120p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91009723. Source: OSTI; NTIS; INIS; GPO Dep.

This progress report presents the interpretation of data obtained (up to November 1, 1988) from the Prototype Engineered Barrier System Field Tests (PEBSFT) that are being performed for the Yucca Mountain Project (YMP) in G-Tunnel within the Nevada Test site. The PEBSFTs are being conducted to evaluate the applicability of measurement techniques, numerical models, and procedures developed for the field tests for future investigations that will be conducted in the Exploratory Shaft Facilities, at a potential high-level radioactive waste repository site in Yucca Mountain. The primary objective of the tests is to provide the basis for determining whether tests planned for Yucca Mountain have the potential to be successful. Thirteen chapters discuss the following: mapping the electromagnetic permittivity and attenuation rate of the rock mass; changes in moisture content detected by the neutron logging probe; characterization of the in-situ permeability of the fractured tuff around the heater borehole; electrical resistance heater installed in a 30-cm borehole; relative humidity measurements; the operation, design, construction, calibration, and installation of a microwave circuit that might provide partial pressure information at temperatures in excess of 200°C (392°F); pressure and temperature measurements in the G-Tunnel; the moisture collection system, which attempts to collect steam that migrates into the heater borehole; The borehole television and borescope surveys that were performed to map the location, orientation, and aperture of the fractures intersecting the boreholes; preliminary scoping calculations of the hydrothermal conditions expected for this prototype test; the Data Acquisition System; and the results of the PEBSFT, preliminary interpretations of these results, and plans for the remainder of the test. Chapters have been indexed separately for inclusion on the data base.

14313 (UCRL–15964) **Closure development for high-level nuclear waste containers for the tuff repository: Phase 1, Final report.** Robitz, E.S. Jr. (Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Div.); McAninch, M.D. Jr.; Edmonds, D.P. Lawrence Livermore National Lab., CA (USA); Babcock and Wilcox Co., Lynchburg, VA (USA). Nuclear Power Div.; Babcock and Wilcox Co., Alliance, OH (USA). Research and Development Div. Sep 1990. 121p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91009760. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes Phase 1 activities for closure development of the high-level nuclear waste package task for the tuff repository. Work was conducted under U.S. Department of Energy (DOE) Contract 9172105, administered through the Lawrence Livermore National Laboratory (LLNL), as part of the Yucca Mountain Project (YMP), funded through the DOE Office of Civilian Radioactive Waste Management (OCRWM). The goal of this phase was to select five closure processes for further evaluation in later phases of the program. A decision tree methodology was utilized to perform an objective evaluation of 15 potential closure processes. Information was gathered via a literature survey, industrial contacts, and discussions with project team members, other experts in the field, and the LLNL waste package task staff. The five processes selected were friction welding, electron beam welding, laser beam welding, gas tungsten arc welding, and plasma arc welding. These are felt to represent the best combination of weldment material properties and process performance in a remote, radioactive environment. Conceptual designs have been generated for these processes to illustrate how they would be implemented in practice. Homopolar resistance welding was included in the Phase 1 analysis, and developments in this process will be monitored via literature in Phases 2 and 3. Work was conducted in accordance with the YMP Quality Assurance Program. 223 refs., 20 figs., 9 tabs.

14314 (UCRL-JC–104531) **Overview of chemical modeling of nuclear waste glass dissolution.** Bourcier, W.L. Lawrence Livermore National Lab., CA (USA). Feb 1991. 19p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-901105–109: Fall meeting of the Materials Research Society, Boston, MA (USA), 24 Nov - 1 dec 1990). Order Number DE91009625. Source: OSTI; NTIS; INIS; GPO Dep.

Glass dissolution takes place through metal leaching and hydration of the glass surface accompanied by development of alternation layers of varying crystallinity. The reaction which controls the long-term glass dissolution rate appears to be surface layer dissolution. This reaction is reversible because the buildup of dissolved species in solution slows the dissolution rate due to a decreased dissolution affinity. Glass dissolution rates are therefore highly dependent on silica concentrations in solution because silica is the major component of the alteration layer. Chemical modeling of glass dissolution using reaction path computer codes has successfully been applied to short term experimental tests and used to predict long-term repository performance. Current problems and limitations of the models include a poorly defined long-term glass dissolution mechanism, the use of model parameters determined from the same experiments that the model is used to predict, and the lack of sufficient validation of key assumptions in the modeling approach. Work is in progress that addresses these issues. 41 refs., 7 figs., 2 tabs.

14315 (WHC-EP–0393-Pt.1) **Hanford Waste Vitrification Plant quality assurance program description: Overview and applications: Part 1.** Caplinger, W.H. Westinghouse Hanford Co., Richland, WA (USA). Dec 1990. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91009416. Source: OSTI; NTIS; INIS; GPO Dep.

This document describes the Hanford Waste Vitrification Plant Project Quality Assurance Program. This program is being implemented to ensure the acceptability of high-level radioactive canistered waste forms produced by the Hanford Waste Vitrification Plant for disposal in a licensed federal repository. The Hanford Waste Vitrification Plant Quality Assurance Program is comprised

of this Quality Assurance Program Description as well as the associated contractors' quality assurance programs. The objective of this Quality Assurance Program Description is to provide the Hanford Waste Vitrification Plant Project participants with guidance and direction for program implementation while satisfying the US Department of Energy Office of Civilian Radioactive Waste Management needs in repository licensing activities with regard to canistered waste forms. To accomplish this objective, this description will be prepared in three parts: Part 1 - Overview and applications document; Part 2 - Development and qualification of the canistered waste form; Part 3 - Production of canistered waste forms. Part 1 describes the background, strategy, application, and content of the Hanford Waste Vitrification Plant Quality Assurance Program. This Quality Assurance Program Description, when complete, is designed to provide a level of confidence in the integrity of the canistered waste forms. 8 refs.

14316 (WHC-EP–0393-Pt.2) **Hanford Waste Vitrification Plant quality assurance program description for defense high-level waste form development and qualification: Part 2.** Hand, R.L. Westinghouse Hanford Co., Richland, WA (USA). Dec 1990. 105p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91009417. Source: OSTI; NTIS; INIS; GPO Dep.

The US Department of Energy-Office of Civilian Radioactive Waste Management has been designated the national high-level waste repository licensee and the recipient for the canistered waste forms. The Office of Waste Operations executes overall responsibility for producing the canistered waste form. The Hanford Waste Vitrification Plant Project, as part of the waste form producer organization, consists of a vertical relationship. Overall control is provided by the US Department of Energy-Environmental Restoration and Waste Management Headquarters; with the US Department of Energy-Office of Waste Operations; the US Department of Energy- Headquarters/Vitrification Project Branch; the US Department of Energy-Richland Operations Office/Vitrification Project Office; and the Westinghouse Hanford Company, operations and engineering contractor. This document has been prepared in response to direction from the US Department of Energy-Office of Civilian Radioactive Waste Management through the US Department of Energy-Richland Operations Office for a quality assurance program that meets the requirements of the US Department of Energy. This document provides guidance and direction for implementing a quality assurance program that applies to the Hanford Waste Vitrification Plant Project. The Hanford Waste Vitrification Plant Project management commits to implementing the quality assurance program activities; reviewing the program periodically, and revising it as necessary to keep it current and effective. 12 refs., 6 figs., 1 tab.

14317 (WHC-SA–1118) **The Hanford Site solid waste treatment project; Waste Receiving and Processing (WRAP) Facility.** Roberts, R.J. Westinghouse Hanford Co., Richland, WA (USA). Jan 1991. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. (CONF-910270–33: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91009362. Source: OSTI; NTIS; INIS; GPO Dep.

The Waste Receiving and Processing (WRAP) Facility will provide treatment and temporary storage (consisting of in-process storage) for radioactive and radioactive/hazardous mixed waste. This facility must be constructed and operated in compliance with all appropriate US Department of Energy (DOE) orders and Resource Conservation and Recovery Act (RCRA) regulations. The WRAP Facility will examine and certify, segregate/sort, and treat for disposal suspect transuranic (TRU) wastes in drums and boxes placed in 20-yr retrievable storage since 1970; low-level radioactive mixed waste (RMW) generated and placed into storage at the Hanford Site since 1987; designated remote-handled wastes; and newly generated TRU and RMW wastes from high-level waste (HLW) recovery and processing operations. In order to accelerated the WRAP Project, a partitioning of the facility functions was done in two phases as a means to expedite those parts of the WRAP duties that were well understood and used established technology, while allowing more time to better define the processing functions needed for the remainder of WRAP. The WRAP Module 1 phase one, is to provide the necessary nondestructive examination and nondestructive assay services, as well as all transuranic package transporter (TRUPACT-2) shipping for both WRAP Project phases, with heating, ventilation, and air conditioning; change rooms; and administrative services. Phase two of the project, WRAP Module 2, will provide all necessary waste treatment facilities for disposal of solid wastes. 1 tab.

14318 (WHC-SA–1119) **Waste Receiving and Processing (WRAP) Project status.** Swenson, J.A. Westinghouse Hanford Co., Richland, WA (USA). Jan 1991. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. (CONF-910270–31: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91009363. Source: OSTI; NTIS; INIS; GPO Dep.

Waste Receiving and Processing (WRAP) Module 1 (WRAP-1) Facility conceptual design was completed in 1989, and the advanced conceptual design for WRAP-1 commenced in April 1990 leading to definitive design beginning January 1991. The engineering study WRAP Module 2 (WRAP-2) Facility has been completed, and a preliminary conceptual design was initiated in April 1990. In summary: WRAP-1 Project was validated in fiscal year (FY) 1989 as an FY 1991 line item; WRAP-1 conceptual design has been completed; advanced conceptual design started in FY 1990; WRAP-2 Conceptual Design started in FY 1990 for an FY 1993 line item Operations of WRAP-1 to start in FY 1997; operations of WRAP-2 to start in FY 1999; Architect-Engineer (A–E) contractor selection for WRAP-1 has been completed; and total estimated cost (TEC) for WRAP-1 is $53,600,000 and WRAP-2 is ~$300,000,000.

14319 (WSRC-MS–90-266) **Decontamination of a benzene waste stream containing Cs-137 and diphenylmercury.** Bibler, J.P. (Westinghouse Savannah River Co., Aiken, SC (USA)); Deininger, J.P. Westinghouse Savannah River Co., Aiken, SC (USA). [1991]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. (CONF-910270–30: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91009338. Source: OSTI; NTIS; INIS; GPO Dep.

A secondary waste stream from the Defense Waste Processing Facility at the Savannah River Site will contain benzene and entrained higher boiling organic derivatives of benzene, Cs-137, and diphenylmercury. This stream constitutes a mixed waste that will have to be decontaminated before disposal. Removal of both diphenylmercury and Cs-137 represents the optimum decontamination of the mixture. Decontamination studies have been conducted on this organic product waste stream to remove both Cs-137 and diphenylmercury. Cesium can be effectively removed by conventional ion exchange techniques using zeolite as the ion exchange medium. It can also be extracted from the benzene phase by washing with water or dilute caustic solution. Diphenylmercury is much more difficult to separate from the benzene. Treatment of the benzene waste with Tru Clear™, a stabilized ferrate (FeO_4^{2-}) system in dilute KOH, allowed extraction of nearly all of the cesium ion and 1–2% of dissolved mercury into an aqueous phase where they can be more easily managed. 3 refs., 1 fig., 3 tabs.

14320 (Y/DV–1052) **West End Treatment Facility corrosion status.** Koger, J.W. Oak Ridge Y-12 Plant, TN (USA). 20 Mar 1991. 31p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91009909. Source: OSTI; NTIS; INIS; GPO Dep.

During the routine inspection of the West End Treatment Facility (WETF) Tank Farm No. 2, wall thickness problems were detected on Tanks F4 and F6. Inspection was accomplished by using a straight beam ultrasonic thickness tester calibrated by use of standard gauge blocks. Initial thinking was that the problem was caused by internal corrosion. In an effort to confirm the cause of the thin wall thickness readings, an internal inspection was conducted. This inspection failed to reveal any visible problems on the internal tank walls. While inside the tanks, some visible corrosion problems on the tank floor were observed. Pitting, as measured with a standard pit gauge, was determined to be as much as 0.180 inches compared to a standard floor thickness of 0.250 inches. Radiographic inspection of the tank walls failed to reveal any specific

voids. Angle beam ultrasonic inspection of the walls was then conducted and showed wall metal thickness values of .370-.375 inches at all locations checked compared to the standard wall thickness of .375 inches. This report describes the WETF and the tanks, the results from tests on a flour sample from on tank, corrosion mechanisms, cathodic protection, possible repair scenarios, decontamination and results from a root cause analysis. 6 figs.

0530 Environmental Aspects

Refer also to citation(s) 14294, 14337, 14339, 14341, 14344, 14345, 15303

14321 (INIS-mf–12807, pp. 2.1-2.6) **Stability of natural barriers exposed to uranium mill wastes.** Clifton, A.W. (Clifton Associates Ltd., Regina, SK (Canada)); Smith, A. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Till, silt, clay, peat and soils modified with commercial bentonite can be considered for use as barriers to seepage from uranium mill wastes impoundments. Hydrogeochemical processes including dissolution, reactions, replacement reactions, precipitation reactions and ion exchange may alter the physical characteristics of the barrier materials. Similarly, the permeability of the barrier may be altered due to physical changes such as swelling, development of cracks or fissures, or piping. This paper explores how physical and geochemical processes may affect the performance of natural soil barriers.

14322 (INIS-mf–12807, pp. 2.28-2.32) **Radiological implications of regional uranium development.** Lush, D.K. (Beak Consultants Ltd., Toronto, ON (Canada)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Studies were carried out on the radiological consequences of releases of uranium and thorium decay series radionuclides to the air and water from the Rabbit Lake, Cluff Lake and Key Lake mines in northern Saskatchewan. Sources of radionuclides were discharge from the water treatment systems, and releases in the form of radon gas and particulate radionuclides from the mining and milling operations. The concentrations of incremental radionuclides in the water, fish, moose, caribou, berries and other foods consumed by the local population were calculated. The analysis showed that about 70 percent of the dose was derived from radon release and subsequent inhalation of radon and its daughters. The second highest dose, about 20 percent, was derived from ingestion of caribou that had consumed lichens containing radon decay products. The high dilution involved in the aquatic pathway and the long hydraulic residence time in the lakes resulted in a very small fraction of the total dose coming from this pathway. Radon is the radioisotope released in the largest quantity by uranium mining and milling operations, calculated in this study to be 500 TBq/a for a large mine and mill complex such as Key Lake. Background radon releases for ordinary soils are on the order of 10,000 TBq/a within the 80 km radius modeled around each mine site. Thus the radionuclides released from the mines very rapidly become difficult to separate from background levels. The incremental radiological doses received by individuals in the region are calculated to be a small percentage of natural background. Regional overlap of operations with respect to their radiological dose consequences need only be investigated in detail when facilities are within about 50 km of each other or discharge into watersheds with low dilution potential or short hydraulic transport times.

14323 (INIS-mf–12807, pp. 2.33-2.39) **Modelling the effects of uranium mine tailings on a permafrost environment.** Barnett, D.M. (Dept. of Indian Affairs and Northern Development, Ottawa, ON (Canada)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

A model is established to describe and predict the effects of uranium mine tailings on the hydrological and thermal environments of the Keewatin where permafrost is a significant condition to be managed. The model couples the water and energy fluxes to melt snow, evaporate water and thaw the active layer. The tailings can be dry or submerged. They can be covered with a variety of materials. Model parameters are based on field data appropriate to a remote environment.

14324 (PNL–6964-HEDR) **A history of major Hanford facilities and processes involving radioactive material: Hanford Environmental Dose Reconstruction Project.** Ballinger, M.Y.; Hall, R.B. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 90p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009778. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Environmental Dose Reconstruction (HEDR) Project was established in 1987 to estimate radiation doses that people could have received from nuclear operations at the Hanford Site since 1944. Hanford Site operations began in 1944 to produce plutonium for nuclear weapons. This effort included fabricating fuel elements, irradiating the fuel in nuclear reactors, and separating the resulting plutonium from uranium and fission byproducts. To build a foundation for the first step in estimating radiation doses, HEDR staff at the Pacific Northwest Laboratory compiled and summarized historical information that describes the processes and facilities in which radioactive material was generated or used at the Hanford Site. This document categorizes nuclear operations under six processes: fuel fabrication, reactor operations, fuel separations, plutonium finishing, research and development, and tank farms and waste recovery. Historical emission controls and effluent monitoring are discussed for each process. Because Hanford Site operations used the first large-scale nuclear facilities of their kind, process development and effluent control measures evolved as knowledge about the processes improved. Over the years, facilities were added or modified to improve processes, accelerate production, and better control emissions to the environment. 25 refs., 23 figs., 3 tabs.

14325 (RISO-M–2875) **Preliminary environmental impact statement for the Kvanefjeld Uranium Mine.** Pilegaard, K. Risoe National Lab., Roskilde (Denmark). Chemistry Dept. Sep 1990. 130p. Order Number DE91624627. Source: OSTI; NTIS (US Sales Only); INIS.

EFP. Kvanefjeld uranium project. Also available as INIS-MF-8994.

The sources of pollution from a proposed uranium mining and milling complex at Kvanefjeld in South Greenland have been evaluated. The environmental impact assessment was part of a pre-feasibility study. The main aims of this study have been to identify potential pollutants and critical pathways, to evaluate the environmental impact of technical alternatives, and to provide guide-lines for pre-operational environmental studies. The study has identified the open pit, waste dump and tailings impoundment as the most important sources of pollution. The mobility of non-radioactive elements was lower in the tailings than in the ore, whereas the reverse was true for the radioactive elements. The potential pollutants include: Be, F, V, Cr, Mn, Fe, Co, Ni, Zn, As, Se, Rb, Nb, Zr, Mo, Cd, Sb, REE, Hg, Pb, Th, U, Ra-226, Pb-210 and Po-210. This list was based on abundance and mobility in the ore and tailings and general toxicity of the elements. Fluorine is the most mobile of the elements in both ore and tailings. The concentration in ore and tailings may be up to 1% and in combination with its high toxicity, F can then be regarded as the most serious pollutant. (author) 34 tabs., 32 ills., 63 refs.

14326 (WSRC-IM–90-60-Vol.1) **Savannah River Site environmental report for 1989: Volume 1, Text.** Cummins, C.L.; Martin, D.K.; Todd, J.L. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 341p. Sponsored by USDOE, Washington, DC

(USA). DOE Contract AC09-89SR18035. Order Number DE91010159. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this report is to meet three of the primary objectives of the Savannah River Site (SRS) environmental monitoring program. These objectives are to assess actual or potential exposures to populations form the presence of radioactive and nonradioactive materials from normal operations or nonroutine occurrences; to demonstrate compliance with applicable authorized limits and legal requirements; and to communicate results of the monitoring program to the public. This 1989 report contains descriptions of radiological and nonradiological monitoring programs, it provides data obtained from these programs, and it describes various environmental research activities ongoing at the site. Also included are summaries of environmental management and compliance activities, a summary of National Environmental Policy Act activities, and a listing of environmental permits issued by regulatory agencies.

14327 (WSRC-IM-90-60-Vol.2) **Savannah River Site environmental report for 1989: Volume 2, Figures and data tables.** Cummins, C.L.; Martin, D.K.; Todd, J.L. Westinghouse Savannah River Co., Aiken, SC (USA). [1989]. 768p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. Order Number DE91010160. Source: OSTI; NTIS; INIS; GPO Dep.

this volume of Savannah River Site Environmental Report for 1989 (WSRC-IM-90-60) contains the figures and tables referenced in Volume I. The figures contain graphic illustrations of sample locations and/or data. The tables present summaries of the following types of data federal and state standards and guides applicable to SRS operations; concentrations of radioactivity in environmental media; the quantity of radioactivity released to the environment from SRS operations; offsite radiation committed dose from SRS operations; measurements of physical properties, chemicals, and metals concentrations in environmental media; and interlaboratory comparison of analytical results. The figures and tables in this report contain information about the routine environmental monitoring program at SRS unless otherwise indicated. No attempt has been made to include all data from environmental research programs. Variations in the report's content from year to year reflect changes in the routine environmental monitoring program or the inability to obtain certain samples from a specific location. 42 figs., 188 tabs.

0540 Health and Safety

Refer also to citation(s) 14226, 14303, 14543, 14622, 14645, 14648

14328 (BNWI-1017-Del.) **Rupture of plutonium oxide storage container, March 13, 1979.** Battelle-Northwest, Richland, WA (USA). Pacific Northwest Lab. 29 May 1979. 116p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009601. Source: OSTI; NTIS; GPO Dep.

On March 13, 1979, a plutonium oxide storage can ruptured in the 303-C storage facility, which is in the 300 Area of the Hanford Site, Washington. The facility is operated by the Pacific Northwest Laboratory (PNL); three PNL staff members were performing the storage operation. No injuries to these staff members resulted from the occurrence. A Class C Investigation Committee was appointed on March 14, 1979, by the Director, PNL. Subsequently, when the loss estimates became available, the Manager, Department of Energy-Richland Operations Office (DOE-RL), appointed a Class B Investigation Committee in accordance with DOE Manual Chapter 0502. As requested by DOE-RL, the Committee investigated technical elements of the causal sequence and management systems that should have or could have prevented the occurrence. The investigation included: review of the use of the 303-C facilities and the transfer containers; interviews with the involved personnel and their managers; analysis of technical studies related to involved materials and procedures; review of safe operating procedures, radiation work procedures, and transfer requirements applicable to the occurrence; and use of the Management Oversight and Risk Tree (MORT) and the Events and Causal Factors Charting methods. 15 figs.

14329 (BNWI-10011-Pt.2) **Fire incident, 233-S facility, Chemical Processing Department: Date of incident, November 6, 1963: Part 2, Conclusions and recommendations.** Battelle-Northwest, Richland, WA (USA). Pacific Northwest Lab. Apr 1964. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009603. Source: OSTI; NTIS; GPO Dep.

A sudden reversal of air flow, with low order audible and vibrational characteristics, occurred in the 233-S facility at about 1:23 a.m., on November 6, 1963. Air from the process area was forced into the operating gallery as instrument case covers popped open. Operators evacuated promptly and the process was shutdown remotely about six minutes later. At about 1:50 a.m., two radiation monitoring personnel noted a fire in the viewing room and turned in a fire alarm. There are three Fenwal fire detectors, acting at a preset temperature, in the main process area enclosure. The air in this area had not yet become hot enough to activate these detectors at the time the manual alarm was turned in. No automatic detectors were installed in the viewing room or contactor enclosure. This paper discusses the conclusions and recommendations associated with the fire.

14330 (CONF-910602-3) **Seismic requalification of a safety class crane.** Wu, Ting-shu; Moran, T.J. Argonne National Lab., IL (USA). [1991]. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. From American Society of Mechanical Engineers (ASME) pressure vessels and piping conference; San Diego, CA (USA); 23-27 Jun 1991. Order Number DE91006039. Source: OSTI; NTIS; INIS; GPO Dep.

A remotely operated 5-ton crane within a nuclear fuel handling facility was designed and constructed over 25 years ago. At that time, less severe design criteria, particularly on seismic loadings, were in use. This crane is being reactivated and requalified under new design criteria with loads including a site specific design basis earthquake. Detailed analyses of the crane show that the maximum stress coefficient is less than 90% of the code allowable, indicating that this existing crane is able to withstand loadings including those from the design basis earthquake. 3 refs., 8 figs., 2 tabs.

14331 (DOE/NV-336) **Site Specific Plan for environmental restoration and waste management: Five-Year Plan.** USDOE Nevada Operations Office, Las Vegas, NV (USA). Jul 1990. 211p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009376. Source: OSTI; NTIS; GPO Dep.

The Nevada Operations Office (NV) Site Specific Plan (SSP) provides plans for implementation of Corrective Activities Environmental Restoration (ER), and Waste Management Operations at the Nevada Test Site (NTS) and other facilities managed by NV, as identified in the Department of Energy (DOE) Five-Year Plan. The Five-Year Plan establishes a DOE-wide agenda for compliance with all applicable environmental laws, regulations, guidelines, and agreements; and clean-up of DOE facilities. 8 figs., 12 tabs.

14332 (DOL-91010192) **Evaluation of the US Department of Energy's occupational safety and health program for its government-owned contractor-operated facilities.** Occupational Safety and Health Administration, Washington, DC (USA). Dec 1990. 116p. Sponsored by Department of Labor, Washington, DC (USA). Order Number DE91010192. Source: OSTI; NTIS.

The purpose of this report is to present to Secretary of Energy James Watkins the findings and recommendations of the Occupational Safety and Health Administration's (OSHA) evaluation of the Department of Energy's (DOE) programs for worker safety and health at DOE's government-owned contractor-operated (GOCO) nuclear facilities. The OSHA evaluation is based on an intensive and comprehensive review and analysis of DOE's worker safety and health programs including: written programs; safety and health inspection programs; and the adequacy of resource, training, and management controls. The evaluation began on April 10, 1990 and involved over three staff years before its conclusion. The evaluation was initiated by former Secretary of Labor Elizabeth Dole in response to Secretary of Energy James Watkins' request that OSHA assist him in determining the actions needed to assure that DOE has an exemplary safety and health program in place at its GOCOs. 6 figs.

14333 (EGG-WM-9090-Rev.1) **In Situ Vitrification Engineering-Scale Test ES-INEL-4, ES-INEL-5, ES-INEL-6, and**

ES-INEL-7 Test Plan. Weidner, J.R.; Stoots, P.R. EG and G Idaho, Inc., Idaho Falls, ID (USA). Oct 1990. 64p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. Order Number DE91010075. Source: OSTI; NTIS; INIS; GPO Dep.

The In Situ Vitrification Engineering-Scale Tests ES-4, ES-5, ES-6, and ES-7 Product Characterization Test Plan describes the methods and procedures to be used or the physical and chemical characterization of the solid product(s) resulting from the Idaho National Engineering Laboratory engineering scale in situ vitrification tests ES-4, ES-5, ES-6, and ES-7. The goals of this Test Plan are to insure that the product characterization results are sufficient to meet the data needs of the In Situ Vitrification Program and are technically and legally defensible. Important issues addressed by the test plan include sampling and analysis strategy, sampling procedures, laboratory analysis, sample control and document management, equipment, data reporting and validation, quality assurance, specific routine procedures to assess data representativeness, safety and training program, and data management. 9 refs., 1 fig., 3 tabs.

14334 (EGG-WM–9091) **In situ vitrification engineering-scale test ES-INEL-5 test plan.** Stoots, P.R. EG and G Idaho, Inc., Idaho Falls, ID (USA). Jun 1990. 71p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. Order Number DE91010099. Source: OSTI; NTIS; INIS; GPO Dep.

In 1952, the Radioactive Waste Management Complex (RWMC) was established at the Idaho National Engineering Laboratory (INEL). RWMC is located on approximately 144 acres in the southwestern corner of the INEL site and was established as a controlled area for the burial of solid low-level wastes generated by INEL operations. In 1954, the 88-acre Subsurface Disposal Area (SDA) of RWMC began accepting solid transuranic-contaminated waste. From 1954 to 1970, transuranic-contaminated waste was accepted from the Rocky Flats Plant (RFP) near Golden, CO, as well as from other US Department of Energy (DOE) locations. In 1987, the Buried Waste Program (BWP) was established by EG & G Idaho, Inc., the prime contractor at INEL. Following the Environmental Restoration guidelines of the Buried Waste Program, the In Situ Vitrification Program is participating in a Remedial Investigation/Feasibility Study (RI/FS) for permanent disposal of INEL waste, in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This study was requested and is being funded by the Office of Technology Development of the Idaho Operations Office of DOE (DOE-ID). As part of the RI/FS, an in situ vitrification (ISV) scoping study on the treatability of mixed low-level and mixed transuranic-contaminated waste is being performed to determine applicability of ISV to remediation of waste at SDA. This In Situ Vitrification Engineering-Scale Test ES-INEL-5 Test Plan considers the data needs of engineering, regulatory, health, and safety activities for all sampling and analysis activities in support of engineering scale test ES-INEL-5. 5 refs., 3 figs., 4 tabs.

14335 (EGG-WM–9455) **Exploratory research and development project for soil sampling probe investigation.** Thurston, G.C. EG and G Idaho, Inc., Idaho Falls, ID (USA). Feb 1991. 27p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. Order Number DE91010062. Source: OSTI; NTIS; INIS; GPO Dep.

The report investigates a number of design concepts for a soil sampling probe. The design concepts are shown as a series of figures drawn to scale. The probe would be attached to the lower end of a 2-inch diameter drill casing that is inserted into the ground with a steady downward force. It is intended to be used at soil depths of 0-50 feet. Small soil samples will be gathered through the use of a pneumatic jet or a remotely operated mechanical finger. The soil sample will then be transported pneumatically from the tip of the probe to the surface via a sample line in the center of the drill casing. This is achieved by entraining the soil samples in a stream of clean dry nitrogen. At the surface, the soil sample will be filtered from the carrier gas. The report also considers designs that use a carrier capsule. The soil would be remotely placed in a transport capsule at the tip of the probe and pneumatic pressure would be used to force the capsule up the sample line to the surface for retrieval. The soil sampling is to be done without removing the drill casing or using any of the typical coring tools. The sampling system is specifically aimed at soil that may be contaminated with radioactive or toxic materials. The system is suitable for remote operation with a minimum impact and generation of waste. The concepts may also be useful for remote sampling for other applications. 8 figs.

14336 (EGG-WTD–9422) **In situ vitrification application to buried waste: Interim report of intermediate field tests at Idaho National Engineering Laboratory.** Callow, R.A. (EG and G Idaho, Inc., Idaho Falls, ID (USA)); Weidner, J.R.; Thompson, L.E. EG and G Idaho, Inc., Idaho Falls, ID (USA). Jan 1991. 186p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. Order Number DE91010026. Source: OSTI; NTIS; INIS; GPO Dep.

This report describes the two in situ vitrification field tests conducted in July and July 1990 at Idaho National Engineering Laboratory. In situ vitrification, an emerging technology for in-place conversion of contaminated soils into a durable glass and crystalline waste form, is being investigated as a potential remediation technology for buried waste. The overall objective of the two tests was to assess the general suitability of the process to remediate waste structures representative of buried waste found at Idaho National Engineering Laboratory. In particular, these tests, as part of a treatability study, were designed to provide essential information field performance of the process under conditions of significant combustible and metal wastes and to test a newly developed electrode feed technology. The tests were successfully completed, and the electrode feed technology successfully processed the high metal content waste, indicating the process is a feasible technology for application to buried waste. 8 refs., 91 figs., 13 tabs.

14337 (FMPC–2220) **Radionuclide source term reconstruction at the Feed Materials Production Center.** Hill, C.A. Westinghouse Materials Co. of Ohio, Cincinnati, OH (USA). Feed Materials Production Center. Jan 1991. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-86OR21600. (CONF-910603–9: Annual meeting of the American Nuclear Society (ANS), Orlando, FL (USA), 2-6 Jun 1991). Order Number DE91008843. Source: OSTI; NTIS; INIS; GPO Dep.

In 1987 the DOE Feed Materials Production Center (FMPC) published the History of FMPC Radionuclide Discharges to define the total quantity of radionuclides emitted via the air pathway from the FMPC since operations began in 1951. This source term was based on historical records of measured dust collector and scrubber losses. Concurrently, the local population expressed concerns for potential health effects from living near the facility and requested that the Centers for Disease Control (CDC) perform an epidemiological study to determine the health effects from living near the FMPC. A more complete assessment of the source term was required for the CDC to determine whether an epidemiological study was warranted. The paper presents the calculated annual FMPC uranium emissions. The resulting source term is considered by FMPC personnel to be as accurate a reconstruction as is possible using the limited historical data available. 2 refs., 1 fig.

14338 (FMPC/Sub–028) **Demonstration of the Polymeric Barrier System (PBS) for site specific interim control applications at the Feed Materials Production Center, Fernald, Ohio and the Savannah River Plant, Aiken, South Carolina.** Rieser, L.A. (Cincinnati Univ., OH (USA). Coll. of Engineering); Christenson, J.M. Westinghouse Materials Co. of Ohio, Cincinnati, OH (USA). Feed Materials Production Center; Cincinnati Univ., OH (USA). Coll. of Engineering. Jun 1990. 27p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-86OR21600. Order Number DE91009927. Source: OSTI; NTIS; INIS; GPO Dep.

The feasibility of using a water based polymeric barrier system (PBS) for site specific control of contamination was demonstrated by pilot scale field tests at the Feed Materials Production Center (FMPC) and the Savannah River Plant (SRP) during the fall of 1989. Test sections consisting of a wide variety of substrates were selected to demonstrate the use of PBS for specific applications of concern at each site. Using a spray application system all substrates were covered with a continuous polymeric coating which after curing isolated the test sections from the external environment. Results of the field tests indicate that, for many applications, PBS is a better alternative than plastic wrapping or tarpaulins for

contamination and erosion control. It is easy to apply, relatively inexpensive, reduces the risk of tearing and avoids the generation of large amounts of additional waste. 3 refs., 3 tabs.

14339 (INIS-mf-12807, pp. 5.31-5.40) **Solute transport modeling for the preliminary design of shallow aquifer restoration scenarios at the Grand Junction, Colorado UMTRA project site.** Coons, L.M. (Sergent. Hauskins and Beckwith Geotechnical Engineers, Albuquerque, NM (USA)); VanBuskirk, D.R. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943--: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle*. Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

A widely accepted two-dimensional solute transport groundwater model was used to predict the effect of selected aquifer restoration methods on the concentration and distribution of dissolved uranium ions in a shallow alluvial aquifer in Grand Junction, Colorado. Transient flow was modeled for relatively complex simulations including (1) the use of a bentonite slurry wall around the perimeter of the contaminated soil and aquifer, (2) a dewatering trench downgradient of the contaminant source, and (3) a major river adjacent to the contaminant source and slurry wall. Results indicated that either a well or trench system would accelerate the removal of uranium ions from the shallow aquifer. As a result, restoration of the alluvial aquifer was considered technically feasible, and preliminary designs for the selected restoration systems were made. Costs for construction and operation over a ten-year period were estimated to be between $600,000 and $3,000,000 (1987 U.S. dollars) depending upon if and/or how the contaminated water is treated after removal from the aquifer.

14340 (ORNL/RASA-90/2) **Preliminary site survey report of the Copperweld Steel Company, 4000 Mahoning Avenue, NW, Warren, Ohio (CWO001).** Foley, R.D.; Floyd, L.M. Oak Ridge National Lab., TN (USA). Dec 1990. 26p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91009509. Source: OSTI; NTIS; INIS; GPO Dep.

At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducted investigative radiological surveys at the Copperweld Steel Company, 4000 Mahoning Avenue, NW, Warren, Ohio (CWO001) in 1988. The purpose of the surveys was to determine whether the property was contaminated with radioactive residues, principally ^{238}U, derived from the former Manhattan Engineer District (MED) project. The surveys included gamma scans; direct and removable measurements of alpha, beta, and gamma radiation levels; and floor debris sampling for radionuclide analyses. Results of the survey demonstrated no radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program guidelines for radium, thorium, and uranium. The radionuclide distributions were not significantly different from normal background levels in the Ohio area. 7 refs., 11 figs., 3 tabs.

14341 (PNL-7253-HEDR) **Iodine-131 in irradiated fuel at time of processing from December 1944 through December 1947: Hanford Environmental Dose Reconstruction Project.** Heeb, C.M.; Morgan, L.G. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009780. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this document is to provide a record of the iodine-131 releases that were used as source terms in calculating the Phase 1 air pathway doses. The following table provides estimates of monthly iodine-131 releases to the atmosphere from the irradiated fuel processing plants for the time period December 1944 (the first month of dissolution of irradiated fuel from the Hanford Site) through December 1947. The estimated values of iodine-131 contained in the irradiated fuel at the time of processing were calculated using the best available information. Details of the calculations, including the assumptions required to obtain the values and the inherent uncertainties in the values, will be addressed in a Phase 2 HEDR report. The quantity of iodine-131 is released to the atmosphere is obtained by multiplying the calculated iodine-131 content of the fuel being dissolved by a release fraction. The actual release fraction value is uncertain. The release fractions assumed for iodine-131 were based on values that are expected to bound the actual release of iodine-131. The Phase 1 dose estimates from iodine-131 were based on a most probable release factor of 75% with an upward uncertainty bound of 85% and a lower uncertainty bound of 50%. The values shown in the table were input to the Phase 1 Modular Dose Calculation Model, which provided the air pathway doses. 1 tab.

14342 (PNL-7423-HEDR) **Initial communication survey results for the Hanford Environmental Dose Reconstruction Project.** Beck, D.M. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009781. Source: OSTI; NTIS; INIS; GPO Dep.

To support the public communication efforts of the Technical Steering Panel of the Hanford Environmental Dose Reconstruction (HEDR) Project, a public survey was conducted. The survey was intended to provide information about the public's knowledge and interest in the project and the best ways to communicate project results. Questions about the project were included as part of an omnibus survey conducted by Washington State University. The survey was conducted by phone to Washington State residents in the spring of 1990. This report gives the HEDR-related questions and summary data of responses. Questions associated with the HEDR Project were grouped into four categories: knowledge of the HEDR Project; interest in the project; preferred ways of receiving information about the project (including public information meetings, a newsletter mailed to homes, presentations to civic groups in the respondent's community, a computer bulletin board respondent could access with a modem, information displays at public buildings and shopping malls, and an information video sent to respondent); and level of concern over past exposure from Hanford operations. Questions abut whom state residents are most likely to trust about radiation issues were also part of the omnibus survey, and responses are included in this report.

14343 (POEF-T-3544) **Autoclave criticality analysis.** Davis, T.C. (Battelle, Columbus, OH (USA)); Tayloe, R.W. Jr. Portsmouth Gaseous Diffusion Plant, OH (USA). 21 Feb 1991. 54p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-76OR00001. Order Number DE91009508. Source: OSTI; NTIS; INIS; GPO Dep.

This report presents the results of an analysis of the potential for a criticality accident in the autoclaves at the Portsmouth Gaseous Diffusion Plant. The effective multiplication factors of UO_2F_2 and water mixtures in a wide range of geometries and moderation ratios are included. The KENO Va computer code was the primary tool used in the analysis of Keff of the UO_2F_2/water mixtures. The primary conclusion of this study is that the likelihood of a release of UF_6 from a cylinder leading to a critical configuration of a UO_2F_2/water mixture is very low. At some stages of an accidental release, the UO_2F_2 and water could be present in quantities sufficient to form a critical configuration. However, the UO_2F_2 and water are likely to be widely dispersed throughout the autoclave. Because moderated uranium mixtures are not likely to accumulate in a localized region, critical configurations are highly unlikely. Additionally, sensitivity studies indicate that even if uranium materials were to accumulate in a localized region, the uranium and water would have to be combined in near optimal proportions for a criticality to occur. A second conclusion of this study is that the potential for a criticality accident is sensitive to the amount of water in the autoclave. 16 refs., 12 figs., 8 tabs.

14344 (SAND-90-2827) **Pre-Tiger Team Self-Assessment report.** Sandia National Labs., Albuquerque, NM (USA). Jan 1991. 297p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91010019. Source: OSTI; NTIS; INIS; GPO Dep.

The Sandia National Laboratories Pre-Tiger Team Self-Assessment Report contains an introduction that describes the three sites in Albuquerque, New Mexico, Kauai, Hawaii, and Tonopah, Nevada, and the activities associated therewith. The self-assessment was performed October 1990 through December 1990. The paper discusses key findings and root causes associated with problem areas; environmental protection assessment with respect

to the Clean Air Act, Clean Water Act, Comprehensive Environmental Response, Compensation, and Liability Act and the Superfund amendments, Resource Conservation and Recovery Act; and other regulatory documents; safety and health assessment with respect to organization administration, quality assurance, maintenance, training, emergency preparedness, nuclear criticality safety, security/safety interface, transportation, radiation protection, occupational safety, and associated regulations; and management practices assessment. 5 figs. (MHB)

14345 (SAND–90-3192) **PTTSA Action Plan Report.** Sandia National Labs., Albuquerque, NM (USA). Feb 1991. 209p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91010018. Source: OSTI; NTIS; INIS; GPO Dep.

The Pre-Tiger Team Self-Assessment (PTTSA) Report identified findings with respect to the way Sandia National Laboratories (SNL), Albuquerque, (including Tonopah Test Range (TTR) and Kauai Test Facility (KTF)) conducts its environment, safety, and health (ES&H) activities. It presented Action Plan Requirements (APR) addressing these findings. The purpose of this PTTSA Action Plan Report is to assist in managing these action plan requirements by collecting, prioritizing, and estimating required resources. The specific objectives addressed by this report include: collection of requirements for the resolution of the findings presented in the PTTSA Report; consolidation of proposed Action Plan Requirements into logical Action Plan groupings for efficiency of resolution; categorization of Action Plans according to severity of the hazards represented by the findings; provision of a basis for long-range planning and issues management; documentation of the status of the proposed corrective actions; establishment of traceability of the corrective action to the original problem or issue; and integration of these plans into the existing ES&H structure. The Action Plans in this report are an intermediate step between the identification of a problem or a finding in the PTTSA Report and the execution of the solution. They consist of requirements for solution, proposed actions, and an estimate of the time and (where applicable) resources required to develop the solution. This report is an input to the process of planning, resource commitment, development, testing, implementation, and maintenance of problem resolution. 2 figs.

14346 (WHC-SA–1106) **Hanford general employee training - A million dollar cost beneficial program.** Gardner, P.R. Westinghouse Hanford Co., Richland, WA (USA). Feb 1991. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. (CONF-9104135–2: 9. symposium on the training of nuclear facility personnel, Denver, CO (USA), 14-18 Apr 1991). Order Number DE91009415. Source: OSTI; NTIS; INIS; GPO Dep.

In January 1990, Westinghouse Hanford Company implemented an interactive videodisc training program entitled Hanford General Employee Training. Covering all Institute of Nuclear Power Operations general employee training objectives, training mandated by US Department of Energy orders, and training prescribed by internal Westinghouse Hanford Company policies, Hanford General Employee Training presents and manages engaging training programs individually tailored to each of the 9,000 employees. Development costs for a sophisticated program such as Hanford General Employee Training were high compared to similar costs for developing "equivalent" traditional training. Hardware ($500,000) and labor costs ($400,000) totaled $900,000. Annual maintenance costs, equipment plus labor, are totalling about $200,000. On the benefit side, by consolidating some 17 previous Westinghouse Hanford Company courses and more effectively managing the instructional process, Hanford General Employee Training reduced the average student training time from over 11 hours to just under 4 hours. For 9,000 employees, the computed net annual savings exceeds $1.3 million. 2 refs.

14347 (WSRC-MS–90-225) **Savannah River Site new NIM design.** Smoak, A.E. Westinghouse Savannah River Co., Aiken, SC (USA). [1990]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. (CONF-9008132–2: DOE criticality alarm workshop, Los Alamos, NM (USA), 14-16 Aug 1990). Order Number DE91009308. Source: OSTI; NTIS; GPO Dep.

The Savannah River Laboratory (SRL) is developing a replacement Nuclear Incident Monitor (NIM) system. A prototype system has been built for human factors study and for operations testing. The design of the new NIM is based on the existing NIM system, developed at SRL, which has been in operation at the Savannah River Site since 1979. Many of the components of this system have remained unchanged, or with only minimal changes. The design of the new NIM system takes advantage of the extensive maintenance and operation records that have been accumulated on the existing NIM system. These records identified those components of the system that had performed satisfactorily over the years. Most importantly, the records pinpointed the problem areas in the system. Components were that required replacement, and circuitry that required redesign to ensure that the NIM system meets all of the site criteria for safety, accuracy and maintainability were identified. Mechanical changes were made to assure that the new system conforms to all seismic requirements specified in pertinent standards. 7 figs.

0550 Safeguards, Inspection, and Accountability

Refer also to citation(s) 14227, 14346, 14888

14348 (LA–11584-MS) **Bibliography for safeguards 1985–1989.** Jaramillo, G.R. (comp.). Los Alamos National Lab., NM (USA). Apr 1991. 30p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91009850. Source: OSTI; NTIS; GPO Dep.

This bibliography is a compilation of technical reports and publications generated by the Los Alamos National Laboratory's Safeguards and Security R&D Program from 1985 to 1989. 361 refs.

14349 (MLM–3684) **Measurement control for calorimetric assay.** Rakel, D.A. EG and G Mound Applied Technologies, Miamisburg, OH (USA). [1991]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-88DP43495. (CONF-910299–1: Safeguards workshop on measurement control, Albuquerque, NM (USA), 20-22 Feb 1991). Order Number DE91009445. Source: OSTI; NTIS; GPO Dep.

The paper is an overview of measurement control for calorimetric assay. The authors have gathered information from several ANSI and ASTM documents which address this topic and offer some additional information based on experience at EG and G Mound Applied Technologies. The scope is restricted to calorimetric assay for safeguarding tritium and plutonium-bearing materials. The paper discusses the physical models with respect to calorimetric assay and calorimetry; acceptable measurement criteria; reference bases; measurement uncertainty for both calorimetry and gamma-ray spectrometry; controlling the measurement process for both calorimetry and gamma-ray spectrometry; and assessment of the measurement processes. 5 refs. (MB)

14350 (NUREG–0430-Vol.10) **Licensed fuel facility status report: Inventory difference data, July 1, 1989–June 30, 1990: Volume 10.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Material Safety and Safeguards. Feb 1991. 16p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

The Nuclear Regulatory Commission (NRC) is committed to an annual publication of licensed fuel facilities inventory difference (ID) results, after Agency review of the information and completion of any related investigations. Information in this report includes ID results for active fuel fabrication and/or recovery facilities. 1 tab.

0560 Legislation and Regulations

Refer also to citation(s) 14226, 14235, 14267, 14268, 14284, 14544, 14545, 14546, 14547, 14548, 14549, 14550, 14551, 14552, 14553, 14554, 14555, 14556, 14560, 14561, 14562, 14563, 14688

14351 (IAEA-INFCIRC–389) **Project and supply agreement. The text of the agreement of 20 September 1990 between the International Atomic Energy Agency and the Governments of the Republic of Zaire and the United States of America**

concerning the transfer of enriched uranium for a research reactor. International Atomic Energy Agency, Vienna (Austria). Jan 1991. 12p. Order Number DE91625119. Source: OSTI; NTIS (US Sales Only); INIS.

Hard copies are available in English and French from IAEA Division of Publications, Distribution Unit.

The document reproduces the text of the Project and Supply Agreement which was approved by the Agency's Board of Governors on 15 June 1990, and concluded on 20 September 1990, among the Agency and the Governments of the Republic of Zaire and the United States of America for the transfer of enriched uranium for a research reactor in Zaire. The supplied material will be an instrumented fuel element containing uranium enriched to 19.98 percent in the isotope uranium-235. 1 tab.

14352 (INIS-mf–12807, pp. 9.13-9.14) **The implications of the ALARA principle for regulatory dose limits.** Brown, L.D. (Saskatchewan Human Resources, Regina (Canada). Labour and Employment). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Radiation dose control based on the ALARA principle leads to average annual exposures far below the maximum permissible level. Consequently lifetime risk estimates based on continued exposure at this level give a seriously exaggerated impression of hazard. Radiation protection would be better served by a regulatory policy combining a lifetime dose limit which corresponds with an acceptable lifetime cancer risk, with the effective implementation of an ALARA program.

14353 (INIS-SU–231, pp. 17-20) **Classification of risk sources in radiation protection.** Kovalev, E.E. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

2 tabs. KRB-IV. Chast' 1.

Classification of risk sources for quantitative evaluation of rise scale of earth hazards for a person per hour is suggested. According to the given classification the level of earth risk per a person varies whithin 10^{-3} - 10^{-12}, i.e. approximately in the range of 9 orders. The risk of mortality due to radioactive contamination of atmosphere by radioactive effluents and wastes of NPPs and nuclear enterprises is a minimum (7 order). Risk of mortality from radioactive elements in consumption goods and artifiicial radiation sources in environment corresponds to 11 and 10 orders. 2 tabs.

14354 (INIS-SU–231, pp. 24-27) **Improvement in the system of sanitary inspection of using ionizing radiation sources in economy.** Golikov, V.Ya.; Korenkov, N.P.; Pol'skij, O.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Structure of the system of State sanitary inspection of using ionizing radiation sources and radioactive material in economy is considered. The main duties of sanitary-epidemiologic stations, that either have or have not radiological teams, are enumerated. Problems, which solution will optimize activities of the State sanitary inspection in radiation hygiene are formulated.

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Refer also to citation(s) 14710

0701 Physical Isotope Separation

14355 (INIS-mf–12806, pp. 102-113) **Future trends in heavy water production.** Galley, M.R. (Atomic Energy of Canada Ltd., Sheridan Park, ON (Canada). CANDU Operations). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Canada has excess heavy water capacity and is unlikely to need more heavy water plants before the mid-1990s. Heavy water is also produced in Norway, India, and probably also in the People's Republic of China; plants are under construction in Argentina and India. The GS (dual temperature) process is the one used in Canada, although research is continuing into alternative methods of production, particularly hydrogen-water exchange (CECE) processes. Other processes are also reviewed.

14356 (INIS-mf–12806, pp. 307-310) **Large-scale isotope production.** Hatton, W.G. (Atomic Energy of Canada Ltd., Kanata, ON (Canada). Radiochemical Co.). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Medical, industrial and research use of artificially-produced radioisotopes has increased steadily over the past 40 years. Canada started producing isotopes in reactors in 1947, and today Canada supplies a major part of the world's requirements for primary nuclides. Reactor and cyclotron facilities, isotope processing facilities and capabilities, waste disposal, and distribution considerations involved in producing isotopes are discussed with particular reference to Co-60, Mo-99, C-14, I-125, Xe-133, Ir-192, Ga-67 and Tl-201.

14357 (INIS-mf–12806, pp. 311-316) **Development of the radioisotope program in Taiwan.** Lin, T.K. (Institute of Nuclear Energy Research (Taiwan)); Chien, J.P. Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Radioisotope production and use are very important in Taiwan. In the past, attention was focussed mainly on the production of radioisotopes. In the future, equal weight will be placed on both production and applications. There will be a national organization to coordinate the efforts of government officials, isotope producers and users.

0702 Radiation Sources

Refer also to citation(s) 15363, 15367, 15368, 15374, 15678

14358 (ANL/CP–72633) **Cold moderators for pulsed neutron sources.** Carpenter, J.M. Argonne National Lab., IL (USA). [1990]. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-9003100–5: International workshop on cold neutron sources, Los Alamos, NM (USA), 5-8 Mar 1990). Order Number DE91010594. Source: OSTI; NTIS; INIS; GPO Dep.

This paper reviews cold moderators in pulsed neutron sources and provides details of the performance of different cold moderator materials and configurations. Analytical forms are presented which describe wavelength spectra and emission time distributions. Several types of cooling arrangements used in pulsed source moderators are described. Choices of materials are surveyed. The author examines some of the radiation damage effects in cold

moderators, including the phenomenon of "burping" in irradiated cold solid methane. 9 refs., 15 figs., 4 tabs.

14359 (CONF-910603–8) **Pressure dynamics modeling for the design of the Advanced Neutron Source reactor.** Khayat, M.I. (Tennessee Univ., Knoxville, TN (USA)); Dodds, H.L.; March-Leuba, J. Oak Ridge National Lab., TN (USA). [1991]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From Annual meeting of the American Nuclear Society (ANS); Orlando, FL (USA); 2-6 Jun 1991. Order Number DE91007860. Source: OSTI; NTIS; INIS; GPO Dep.

This paper summarizes the development of a computer model to study the pressure and flow dynamics of the Advanced Neutron Source (ANS) reactor. Included in this paper are some applications of this model to aid in the conceptual design of the reactor cooling systems. The ANS will be primarily a neutron scattering facility, but it is also being designed for isotope production and irradiation experiments. To accomplish these goal, the ANS design is based on a high power (362 MW_{fis}) compact core (67 L) surrounded by a large (1.75 m radius) D_2O reflector where most of the neutrons generated in the core by fission are moderated and available for scattering experiments.

14360 (IAEA-TECDOC–576, pp. 91-107) **Cost variables for food irradiators in developing countries.** Morrison, R.M. (Department of Agriculture, Washington, DC (USA). Economic Research Service); Roberts, T. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

Irradiating food in a cobalt-60 irradiator in a developing country is estimated to cost between 1.2 and 13.0 U.S. cents per kilogram (kg) depending on the size of the irradiator, radiation dose, and number of shifts operated. (Costs for this analysis are in U.S. currency reflecting 1985 prices.) In the base case where the irradiator is operated two shifts per day 250 days a year delivering a dose of 2.5 kilograys (kGy) with an hourly throughput of 6,000 kg, the unit cost is 4.8 U.S. cents per kg. The most significant cost items are the cobalt-60 source, buildings and shielding, and machinery. These items account for 65% of total capital and operating costs in the base case. Total capital and operating costs for such a non-batch food irradiator are estimated at U.S.$ 1 million annually. The initial investment cost is estimated to be U.S.$ 3.5 million. (author). 2 refs, 2 figs, 6 tabs.

14361 (IC–90/327) **The drying of manioc using solar energy.** Barry, M.B. (International Centre for Theoretical Physics, Trieste (Italy)); Diallo, M.L. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 7p. (In French). Order Number DE91625861. Source: OSTI; NTIS (US Sales Only); INIS.

A solar dryer used in Guinea for the drying of manioc is described. 3 refs, 3 figs.

14362 (INIS-mf–12806, pp. 329-335) **Radiation vulcanization of natural rubber latex.** Ridwan, M. (National Atomic Energy Agency, Jakarta (Indonesia)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Radiation vulcanization of natural rubber is much simpler and uses less energy than the conventional thermal process. Additional advantages are: long shelf life of vulcanized or cured latex; fewer chemicals in products, transparent products; simplicity and ease of control of process; energy savings. The process uses a cobalt 60 source.

14363 (ORNL–6656) **Advanced Neutron Source (ANS) Project: Progress report.** Campbell, J.H. (ed.); Selby, D.L.; Harrington, R.M.; Peretz, F.J. Oak Ridge National Lab., TN (USA). Feb 1991. 90p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010493. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the research and development, design and safety of the Advanced Neutron Source at Oak Ridge National Laboratory. (LSP)

0704 Economic, Industrial, and Business Aspects

Refer also to citation(s) 15363, 15365, 15367, 15374, 15379

14364 (INIS-mf–12807, pp. 11.23-11.25) **Radioisotopes - byproducts of the uranium cycle with commercial applications.** Evans, D.J.R. (Atomic Energy of Canada Ltd., Kanata, ON (Canada). Radiochemical Co.). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Several fission products are used in industry, medicine and research. Cesium 137 and strontium 90 are the most useful long-lived fission products recovered from the processing of spent reactor fuel. The short-lived isotopes molybdenum 99, xenon 133 and iodine 131 are more widely used, particularly in medicine. Technetium 99, daughter of molybdenum 99, is now the most widely used isotope for in-vivo diagnosis. More than 65 percent of all the molybdenum 99 from which this material is derived comes from uranium targets irradiated in reactors at Chalk River Nuclear Laboratories. Transuranic elements produced by successive neutron capture/decay events in a reactor have at least one commercial application: americium 241 is used in domestic and industrial smoke detectors. Plutonium 238 or americium 241 are combined with beryllium as neutron sources for oil well logging or moisture measurement. Many other isotopes are produced by target irradiation in reactors, including cobalt 60, iodine 125, carbon 14 and iridium 192. New uses are being found for the tritium produced in CANDU reactors by neutron capture in heavy water. Many radioisotopes produced as byproducts of the nuclear fuel cycle have become essential to our high standard of living. Canada is not only the world's largest uranium producer but also the major supplier of reactor isotopes.

0705 Health and Safety

14365 (INIS-SU–231, pp. 13-17) **Radiation protection when use of radionuclide sources in economy is increasing.** Kodyukov, V.M.; Chistov, E.D.; Cherevatenko, G.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

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Problems of further development of technical means for radiation safety (RS) of personnel, population and environment, taking into account technical-and-economical potentialities and social postef-fects of wide application of products with radionuclide sources, are considered. It is shown that indices of radiation safety of used radiation equipment are constantly improved due to control means, optimum selection of specific activity, use of new shielding materials and improvement of radiation shielding designs and transport containers, and also use of monitoring and alarm systems. Much attention in RS provision system is paid to control over labour safety under design, construction and operation of radiation equipment, formulation of technical and sanitary regulations, personnel training in safety operation technique, popularization of progressive methods.

08 HYDROGEN

0801 Production

Refer also to citation(s) 13949, 14123

14366 (DOE/METC–90/6112, pp. 82-88) **Development of an electrochemical hydrogen separation device.** Kush, A.K. (Energy Research Corporation, Danbury, CT (USA)); Rostrup-Nielsen, T. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The objective of this program is to develop an electrochemical hydrogen separation device [EHSD] for cost-effective hydrogen recovery from coal-derived gases. The potential applications are high purity hydrogen recovery from oxygen and air blown gasifiers as well as hydrogen-lean streams such as a carbonate fuel cell anode exhaust. In the present program, the effect of design and operating parameters (e.g. pressure, temperature, H_2 recovery and electrochemical catalyst loading) on EHSD performance will be characterized in single subscale cells (25 cm^2 active area) and presented as a mathematical model. Scaleup, full size (1,000 cm^2) multi-cell-stack long term (~ 3,000 hours) operation and product purity will also be demonstrated. Process conceptual design and economics for a potential application will be evaluated for the EHSD and a competing technology.

14367 (ENET–8900448/1) **Preliminary project of a solar hydrogen pilot plant for decentralized energy systems.** Real, M.G. (Alpha Real AG, Zuerich (CH)). Bundesamt fuer Bildung und Wissenschaft, Bern (Switzerland). Apr 1989. 39p. (in German). Order Number DE91765863. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

This is a feasibility study, the purpose of which is to investigate the possibility of decentralized means to produce hydrogen using solar energy, and to store and consume same. 'Decentralized' means that large haulage distances between the producer of solar hydrogen and the consumer would not be required. As a result, a preliminary project involving a pilot plant to generate from one to ten kilowatt was chosen. As storage means for the solar hydrogen produced, provision was made among other possibilities to hydrogenate CO_2 to methanol. As a result of this study, there are two recommendations that can be made: first, a planning of details including an evaluation of the location, and second, an investigation of the possibilities and problems underlaying the production, storage and use of methanol by hydrogenating CO_2 with hydrogen. figs., tabs.

14368 (EUR–12693) **Development and production of electrode-diaphragm-electrode units – EDE – for cost reduction in alkaline water electrolysis: Final report.** Wendt, H. (Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Chemische Technologie); Hofmann, H.; Blaise, M.; Rausch, S. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Technische Hochschule Darmstadt (Germany, F.R.). Inst. fuer Chemische Technologie. 1990. 38p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract EN3V-0008-D(B). Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 5.

For energy and cost savings in the production of hydrogen by alkaline water electrolysis a unit consisting of cathode anode and diaphragm was developed which substitutes the conventionally used perforated sheet electrodes and the harmful asbestos diaphragms. This unit called EDE-unit (i.e. electrode-diaphragm-electrode unit) offers an optimal cell configuration with low ohmic energy losses. The whole EDE-unit is composed of two porous nickel electrodes adhering to and covering an intercalacted porous cermet layer made from $CaTiO_3$ or $BaTiO_3$ as ceramic component and nickel particles. The procedure to prepare EDE-units is tape casting of the diaphragm layer, sieve printing of the electrodes in oxidic form, sintering of the ceramic component and final reduction of the nickel oxide in hydrogen atmosphere. EDE units were tested in long term electrolysis over 7000 hours and at current density of 250 mA/cm^2 at 90°C in 30% KOH and ambient pressure. To avoid high contact resistances between the EDE-anode and the studded bipolar wall the EDE-anode is stuck to the bipolar plate with a nickel oxide slurry and the nickel oxide is reduced to nickel in hydrogen atmosphere to form a tight contact. EDE-units in a size of 30 x 15 cm^2 were prepared and scaling up to a format of 1x1 m^2 seems possible using a gas fired ceramic furnace with very low temperature gradients to avoid uncntrolled shrinking. The total raw material costs of EDE units amount to approximately 130 DM/m^2. Different polymeric materials were investigated for their suitability as frame material of the EDE-units and only PEEK (ICI) was stable in 30% KOH at 150°C under 5 bars of O_2. Efforts were made for activation of the EDE-electrodes by Ni/Co-oxides and by Raney-nickel. 10 refs., 17 figs., 6 tabs.

14369 (EUR–12712) **Development of a new method for hydrogen recovery from lean gas mixtures (e.g., producer gas) using metal hydride slurries: Final report.** Knippels, J.P.M.H. (Technische Univ. Twente, Enschede (Netherlands)); Holstvoogd, R.D.; de Laat, G.J.; Ptasinsky, K.J.; Versteeg, G.F.; van Swaaij, W.P.M. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Technische Univ. Twente, Enschede (Netherlands). 1990. 193p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract EN3B-0107-NL. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

Hydrogen plays a key role in producing and upgrading liquid fuels from biomass. Hydrogen containing gases can be produced from biomass by gasification. A new, continuous hydrogen recovery technology uses metal hydrides, alloys capable of absorbing large amounts of hydrogen, suspended in an inert liquid. During the present research period the principle of continuous hydrogen recovery has been demonstrated. The effect of the reaction kinetics between hydrogen and the metal hydrides, mass transfer phenomena, hydrodynamics of this gas-liquid-solid system and physico-chemical constants on the efficiency of this hydrogen recovery process were studied. On pilot-plant scale the hydrodynamics and hydrogen absorption rates were investigated. A valve tray column served as gas liquid contactor and experiments with pure hydrogen as well as experiments with a gas consisting of nitrogen and hydrogen were carried out. The presence of nitrogen resulted in a decrease of the hydrogen uptake rate, no loss in loading capacity was observed however. The absorption kinetics of hydrogen in metal hydride slurries suspended in inert silicon oil was studied independently in a stirred vessel model reactor. Two types of metal hydrides, $LaNi_5$ and $LaNi_{4.7}Al_{0.3}$, were investigated. From the results it could be concluded that the reaction was first order in hydrogen and that the temperature dependence of the reaction rate was the same for both hydrides. For the description of the gas absorption in slurries, theoretical models, necessary for the design and development of large-scale hydrogen recovery processes, were developed. These models were also useful for the interpretation of the experiments. The appendices contain individual papers detailing the several phases of this project. These were indexed separately for inclusion on the data base.

09 BIOMASS FUELS

0907 Resources

Refer also to citation(s) 14371, 14747

0908 Production

Refer also to citation(s) 14747

14370 (EUR–12692) **Sweet sorghum (sorghum bicolor) as an alcoholic hill cultivation.** Belletti, A. (Distillerie ORBAT SpA, Forli (Italy). Centrale Ortofrutticola alla Produzione); Biotec, A.

Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Distillerie ORBAT SpA, Forli (Italy). Centrale Ortofrutticola alla Produzione. 1990. 93p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract EN3B-0035-1 (S). Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

During three years period 1986–1988, with the financial support of EEC, we conducted a research work on sweet sorghum, following this scheme. We conducted some agronomic trials in order to point out the best cultivation technics: in detail we study the varietal comparison, the comparison among different harvesting and sowing seasons, among different sowing distances, monostelic and tillered plants, the study of the accumulation curve of the simple carbohydrates in the stalk and a comparison among different hybrids F1 coming from breeding program. We also began a breeding program aimed to these objectives: (a) achievement of sugar lines, at low size, sterile-male to employ in the hybrids production; (b) development of pure sugar lines at measured height to employ as pollinatings in the hybrids production; (c) development of pure monostelic lines; (d) development of the cold tolerance, in germination phase of the seed; (e) development of partial restorer lines for the hybrids production with low productivity in seed. With the collaboration of Bologna University and of a distillery we also studied some aspects of the processing of the producted bagasse: the mechanical harvesting, the extraction and storage of sugar juices and the use of the bagasse. 13 refs., 10 figs., 21 tabs.

14371 (EUR–12713) **Investigations on short rotation forestry for energy: Final report.** Mitchell, C.P. (Aberdeen Univ. (UK). Dept. of Forestry). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Aberdeen Univ. (UK). Dept. of Forestry. 1990. 76p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract EN3B-0029-UK. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The aim of the project was to develop appropriate silvicultural systems for growing forest biomass for energy on short rotation. Species selection, yields, use of herbicides and fertilizers, nutrient removals, management structure and environmental impact are all being considered. There were 7 components to this coordinated program of work: (1) monitoring of existing trials of single stem energy plantations; (2) monitoring of existing trials of coppice energy plantations; (3) establishment and weed control of willow and poplar coppice energy plantations; (4) establishment and monitoring of large scale trials of coppice energy plantations; (5) examination of the feasibility of integrating farming with forestry for energy; (6) examination of the potential of agroforestry systems for food and fuel production and (7) environmental impact of energy forestry. The work has demonstrated that productivities of over 10 dt/ha/yr are attainable in practice with coppiced willows and poplars grown at a spacing of 1 x 1m on agricultural land. Establishment and management of plantations has to be intense and complete weed control is absolutely essential. Farmers are interested in growing energy forestry crops as an alternative agricultural enterprise providing the economics are right. The availability of resources such as labor and advice are not seen as a major barrier to implementation. The environmental impacts of short rotation energy forestry can be minimized and, where arable land is planted, the effects could be beneficial. Economic analysis of coppice energy plantations indicates that if poplars (16 dt/ha/yr) and willows (10 dt/ha/yr) are grown, with the farmer supplying all the labor. the current industrial energy market can be supplied profitably. 7 figs., 14 tabs.

14372 (EUR–12805) **Harvesting forest biomass for energy.** Mitchell, C.P. (Aberdeen Univ. (UK). Dept. of Forestry). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Aberdeen Univ. (UK). Dept. of Forestry. 1990. 75p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract EN3B-0068-UK. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The aim of this project was to develop and test a machine for harvesting short rotation coppice plantations, and to investigate systems for the efficient and economic harvesting, processing, storing and transporting wood for fuel from conventional forestry in order to develop wood fuel supply systems. The Loughry Coppice Harvester was developed to harvest short rotation coppice crops. It was tested in a 2 year old willow coppice crop achieving a harvesting rate of 3 tonnes per productive machine hour. Overall, harvest, extraction and chipping costs vary from $2.93/GJ to $3.04/GJ, depending on yield of the crop. These are high but the goal is to reduce these considerably though continued development and testing. Three main systems for harvesting wood fuel (residue, whole tree comminution and integrated harvesting systems) from conventional forestry were investigated through a series of 29 harvesting trials. In addition trials were conducted on the storage, drying and transport of comminuted wood fuel. Supply strategies were modelled to provide wood fuel to three sizes of combustion plant (1.5 MW, 6.0 MW and 30.0 MW). The lowest delivered fuel costs, based on integrated harvesting systems in conifer clearfell are $1.17/GJ, $1.31/GJ and $1.54/GJ respectively. Integrated harvesting systems offer the greatest long term potential for cost effective harvesting of wood fuel whereas residue harvesting systems offer the greatest short term potential. Whole tree comminution systems have potential for lowering harvesting costs from early thinnings. Screening and sorting of whole three chips to produce an energy element in conjunction with industrial chips offers scope for further reduction of costs. 8 refs., 13 figs., 25 tabs.

14373 (JTI–115) **Agroforestry. Foreign experiences and potentials for production in Sweden.** Kumm, K.I. Swedish Inst. of Agricultural Engineering, Uppsala (Sweden). Mar 1990. 47p. (In Swedish). Order Number DE91763535. Source: OSTI; NTIS (US Sales Only).

Agroforestry - combined agriculture and forestry on one piece of land - can be an environmentally friendly alternative for farmland that is not needed for specialized agricultural production. This preliminary study explores the economic possibilities for agroforestry in Sweden. Experiences from UK, Italy, USA and New Zealand are reviewed and research needs listed. (L.E.).

14374 (JTI–120) **Grass and grain crops for combustion - Production costs and market conditions.** Dahlgren, L.; Hadders, G. Swedish Inst. of Agricultural Engineering. Uppsala (Sweden). 1990. 66p. (In Swedish). Order Number DE91763537. Source: OSTI; NTIS (US Sales Only).

In this study of the possibilities for fuel production of grass and/or cereals, the following steps have been examined: Systems for handling the crops; schematic economic analyses of possible alternatives; identification of the most promising species; sensitivity analyses of potential cost reductions during the next decade for the most promising species; R and D needs. The analysis shows that at present there is no economic opportunity for growing cereals for fuel in Sweden, and that these crops have small chances to compete with straw and wood chips even if the economic possibilities for biofuels are improved on the whole. (L.E.).

14375 (OY/PSTL–C77) **Short-rotation cultivation of fast-growing willows and plantations of Betula pendula, Roth on Hirvineva, a mire formerly used for peat production, in Liminka, Finland.** Lumme, I.; Kiukaanniemi, E. Oulu Univ. (Finland). Research Inst. of Northern Finland. 1987. 50p. (In Finnish). Order Number DE91763442. Source: OSTI; NTIS (US Sales Only).

This report is concerned with afforestation experiments using fast-growing willows (Salix spp.) and silver birch (Betula pendula, Roth) conducted by the Northern Finland Research Institute of the University of Oulu at the site of a mire formerly used for peat production, Hirvineva in the commune of Liminka (62 deg C 45′ N, 23 deg C 30′ E). Experiments were carried out at the early stages of willow cultivation into the use of chemical fertilizers and peat ash, the liming requirement of the soil and the effects of tilling of the soil on growth. Since 1985 efforts have been concentrated on developing new willow clones. Research was also begun into the mycorhiza which develop when willows are cultivated on peat soils.

The experiments with Betula pendula were devoted to examining the effects of plantation density and fertilization with peat ash on four-year old saplings.

14376 (STEV-EO–91-1) **Growth maximization is deciduous trees optimally supplied with nutrients and water: Report for the period 1987-04-01–19890-06-30.** Christersson, L. (Swedish Univ. of Agricultural Sciences, Uppsala (SE). Dept. of Ecology and Environmental Research); Elowson, S. Statens Energiverk, Stockholm (Sweden). 1990. 44p. (In Swedish). Project STEV-196-084. Order Number DE91763559. Source: OSTI; NTIS (US Sales Only).

In order to develop a deep and voluminous foliage these fast-growing tree species require a relatively good access of water and nutrients. Consequently, the aim of this investigation is to determine in detail the most optimal fertiliser and water conditions for high production. These results will then be used as a base in preparing fertiliser information and extension advice for practical growers of energy plantations with the necessary consideration to both environment and economy. The experimental site are located in the province of Halland (Laanga-Veka) on shifting sand and Uppland (Ultuna) on heavy clay. Irrigation and fertilisation during the growing periods have been done at different intervals ranging from daily to once a week. The fertiliser consisted of all macro- and micro-nutrients in proportions that were considered optimal for high growth. The amounts of fertiliser added expressed in kg N per ha and year vary between 50 and 225. The levels have been exceeded only in exceptional cases. A Salix dasyclados clone produced an amount of woody biomass during one year that corresponded to a production of 26 tonnes DM per ha and year. The results thus confirms earlier statements that, in Sweden, there is no species that has an ability superior to that of certain willow clones to produce biomass in the shape of wood. This applies only under the condition that water and nutrients are available in optimal amounts for the plants and that damage caused by moose, fungi and insects can be minimised. Other clones on the same soils and with the same irrigation and fertilisation routines have produced only half the amounts of biomass mentioned above. On heavy clay, the production of biomass has only amounted to half the level achieved on sand soil. This is considered to depend on the oxygen availability to the roots on heavy clay with daily irrigation being the limiting factor for growth. To this should also be added that heavy clays are usually fairly cold soils.

0909 Processing

Refer also to citation(s) 13982, 14369, 14370, 14372, 14747

14377 (ETDE-mf–1764633) **Dependence of sludge digestion efficiency on mixing efficiency in the digester. Intermediate report.** Teichmann, H. Universitaet der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Inst. fuer Wasserwesen; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Apr 1990 78p. (In German). Contract BMFT 02 WS 8822/4. Order Number DE91764633. Source: OSTI; NTIS (US Sales Only).

The previous section reported on the carrying out and the results of tracer experiments with 10 digesters. The flow characteristics of all digesters showed deviations from the ideal stirring reactor. This is confirmed by short-time analyses where complete mixing of the tracer took different length of time. These samples also pointed out flow anomalies like dead zones or short-circuit flows at an early stage. This was usually confirmed by long-term analyses. Flow anomalies of the different digesters were determined by means of model adaptation and found to differ ins strength. The sewage purification plants at Neufinsing, Pfarrkirchen, Kelheim and Unterfoehring were found to have large dead zone whereby the values for Pfarrkirchen must be taken with a grain of salt due to measuring difficulties mentioned above. Small dead zones or short-circuit flows were found at Raubling, Starnberg and Wolfratshausen. (orig.).

14378 (ETDE-mf–1764635) **Two-stage intensive digestion of municipal sewage sludge by biological phase separation with a thermophilic first stage. Demonstration project. Intermediate report 1-1990.** Kirchhof, W. Forschungsinstitut fuer Wassertechnologie e.V. (FIW), Aachen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Aug 1990 43p. (In German). Contract BMFT 02WS 8734/2. Order Number DE91764635. Source: OSTI; NTIS (US Sales Only).

This intermediate report comprises investigations regarding the concentration of fresh sludge by means of a centrifuge, by two-stage, thermophilic-mesophilic digestion, and by sewage-sludge dehydration using a chamber filter press. Digester gas yield is good, and methane content is 69%. The stabilization of the sewage sludge and gas yield are directly proportional to the retention time in the reactors. (EF).

14379 (EUR–12716) **Continuous ethanol fermentation at 70°C from straw and straw hydrolysates: Final report (January 18th 1990).** Hartley, B.S. (Imperial Coll. of Science, Technology and Medicine, London (UK)); Amartey, S.; Buchell, D.; Leak, D.J.; San Martin, R.; Ward, E. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Imperial Coll. of Science, Technology and Medicine, London (UK). 1990. 57p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract EN3B-0092-UK. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The project has been successful, though in ways somewhat different to those anticipated. An early problem was in developing a defined medium for continuous aerobic and anaerobic cultures of the organism to allow accurate fermentation balances. A more serious problem was that strain LLD-15 reverted to lactate production under conditions that maximize ethanol production in continuous culture. However, development of a continuous system using membrane cell separation and recycle allowed reproducible and accurate growth and product kinetics over prolonged periods. Attempts to develop a host-vector system for the organism so as to use genetic engineering techniques to delete the LLD gene, and for other strain improvement strategies, showed promise but were not completed. However a stable LLD-16 strain was achieved by diepoxybutane mutagenesis and screening fluoropyruvate resistance plus lack of reversion. Moreover analogous mutagenesis and screening for fluoroacetate resistance yielded strains that make more ethanol and less acetate. But the most pleasing discovery was that even the unimproved LLD-15 strain has high ethanol productivity from xylose at 70°C in the cell-recycle system, allowing us to calculate an ethanol production price below $0.30/litre for sugars derived from explosion of wood-chips followed by ethanol extraction to produce paper pulp, this allows prospect of a profitable process producing paper plus ethanol and using lignin as the plant fuel. 30 refs., 5 figs., 7 tabs.

14380 (NEI-DK–497) **Plan of management for biomass conversion plants on farms: Renovation of two farm biogas systems.** Soerensen, F.; Moeller, E. Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). Jun 1990 17p. (In Danish). Contract TR-88.1179. Order Number DE91763366. Source: OSTI; NTIS (US Sales Only).

A description of how 2 biomass conversion plants, both located on farms, were renovated in order to improve the operation of one and the pumping-in system of the other. The text is illustrated with detailed diagrams. (AB).

14381 (NEI-DK–503) **Straw management: Techniques, economy and organization.** Videncenter for Halm- og Flisfyring (Denmark). Nov 1989 38p. (In Danish). Contract EM-151/88-54. Order Number DE91763401. Source: OSTI; NTIS (US Sales Only).

EFP-89.

The aim was to establish to what extent the use of straw in district heating plants could be made more economically attractive by improving methods of the handling, organization and transport of this type of fuel. It is suggested that the efficiency of the processes of compression of straw into bales, loading from the fields, transport to. unloading and storage at the suppliers, reloading and transport to the district heating plants and the price and maintenance of the involved machinery has a marked influence on the price of straw. Suggestions are offered for improving the efficiency of these processes. Other influences are also discussed in relation to actual cases in Denmark. (AB).

14382 (SERI/TP–231-3996) **Ethanol annual report FY 1990.** Texeira, R.H.; Goodman, B.J. (eds.). Solar Energy Research Inst., Golden, CO (USA). Jan 1991. 344p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-83CH10093. Order Number DE91002125. Source: OSTI; NTIS: GPO Dep.

This report summarizes the research progress and accomplishments of the US Department of Energy (DOE) Ethanol from Biomass Program, field managed by the Solar Energy Research Institute, during FY 1990. The report includes an overview of the entire program and summaries of individual research projects. These projects are grouped into the following subject areas: technoeconomic analysis; pretreatment; cellulose conversion; xylose fermentation; and lignin conversion. Individual papers have been indexed separately for inclusion on the data base.

14383 (STEV-AVF–90-2) **Biogas potential in organic wastes in Sweden.** Hagelberg, M. (Jordbruksteknisk Inst., Uppsala (Sweden)); Mathisen, B.; Thyselius, L. Statens Energiverk, Stockholm (Sweden); Swedish Inst. of Agricultural Engineering, Uppsala (Sweden). 1988. 50p. (In Swedish). Project STEV-266-079. (JTI–90). Order Number DE91763509. Source: OSTI; NTIS (US Sales Only).

The total energy potential from organic wastes in Sweden has been calculated to 15.8 TWh/year. Industries and municipalities contribute with 3.1 and 2.2 TWh respectively. Agriculture dominates with 10.5 TWh, of which 6.1 TWh emanates from manure. The greatest energy potential in the industry comes from waste water while household wastes is the dominant source in the municipalities. The entire contribution from industries and municipalities ought to be extractable with present techniques, while the corresponding agricultural part is 3.5 TWh. In total this mean 8.8 TWh/year.

14384 (STEV-FGT–91-1) **Gasification of wood fuels and electric power generation with a diesel engine: Long-term experiment in CFBG-pilot plant at Studsvik.** Waldheim, L. (Studsvik Energy, Nykoeping (SE)); Blackadder, W.H. Statens Energiverk, Stockholm (Sweden); Studsvik Energy, Nykoeping (Sweden). Dec 1990. 182p. (In Swedish). Project STEV-266-093. (STUDSVIK-EP–90-16). Order Number DE91763554. Source: OSTI; NTIS (US Sales Only).

The report is the final report of phase 3 of the project CFBG-diesel. The result of the program was 1300 hours of gasifier operation of which the motor was operated for 700 hours. The over-all conclusions of the activities were that - the gasification process is sufficiently reliable in operation to be able to scale-up although improvement possibilities in terms of tar reduction have been identified. - the motor behaves as expected in term of performance but emissions of carbon monoxide and hydrocarbons are unacceptably high by Swedish standards, whereas emissions of nitrous oxides are low. The reason for these emissions are to a large extent caused by the mechanical design features of diesel engines in general. These design features, which has been developed for air as a working medium, have to be better adapted to the use of a gas-air mixture in order to avoid 'dead spaces' in the cylinder. Also the ignition of the gas-air mixture by pilot oil can be improved by changes in the oil injection system. Further work will therefore concentrate on the improvements possible by better adaption of the motor to this particular fuel in order to reduce emissions, and will to a lesser extent than previously be carried out in the pilot unit.

0910 Properties and Composition

14385 (DOE/CE/40740–2) **A comprehensive program to develop correlations for the physical properties of kraft black liquors: Interim report No. 2.** Fricke, A.L. Florida Univ., Gainesville, FL (USA). Coll. of Engineering. Dec 1990. 80p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-85CE40740. Order Number DE91009792. Source: OSTI; NTIS; GPO Dep.

Experimental work includes pulping, liquor analysis, lignin purification and characterization, vapor-liquid equilibria, heat capacity, heats of solution and combustion, and viscosity measurements. It is now possible to operate the digester as a closed, rotating reactor or as a batch reactor with liquor circulation. When operated with liquor circulation, temperatures within the chip bed can be monitored during cooking. Cooking is reproducible, and cooks are being performed to produce liquors for experimental studies. The digester could be further modified to permit them to conduct rapid exchange batch pulping or to permit them to simulate continuous pulping. Liquors are now routinely analyzed to determine all components, except higher molecular weight organic acids and extractives. Lignin determination by UV-visible means has been improved. Lignin purification from black liquor has been improved and lignin molecular weights are determined routinely. The paper describes the digestor, the large scale evaporation, liquor analysis, thermal studies, and viscosity results. 31 figs., 5 tabs.

14386 (NEI-DK–498, pp. 1-3) **Wood fuels.** Baadsgaard-Jensen, J. (Skovteknisk Institut (DK)). Skovteknisk Inst., Copenhagen (Denmark). 1989. 101p. (In Danish). (CONF-8910517–: Information day on wood chip, and coal/wood chip fired district heating plants with flue gas condensing, Frederiksberg (Denmark), 31 Oct 1989). In *Information day on wood chip, and coal/wood chip fired district heating plants with flue gas condensing.* Order Number DE91763370. Source: OSTI; NTIS (US Sales Only).

A description of bark, wood chips, chunk, crushed wood, sawdust/shavings and other industrial wood waste used for wood-fuelled power plants. The emphasis is on the size of the wood fuel units, production, origin, quality and moisture content. (CLS).

0920 Combustion

Refer also to citation(s) 14043, 14867

14387 (NEI-DK–498) **Information day on wood chip, and coal/wood chip fired district heating plants with flue gas condensing.** Skovteknisk Inst., Copenhagen (Denmark). 1989 101p. (In Danish). (CONF-8910517–: Information day on wood chip, and coal/wood chip fired district heating plants with flue gas condensing, Frederiksberg (Denmark), 31 Oct 1989). Order Number DE91763370. Source: OSTI; NTIS (US Sales Only).

This paper deals with aspects of handling wood fuels, environmental effects of using wood as fuels and the establishment of a wood chip fired district heating plant. (CLS).

14388 (NEI-DK–498, pp. 45-53) **Condensing flue gas cooling in wood-chip-fueled power plants.** Houmann Jakobsen, H. (Skovteknisk Institut (DK)). Skovteknisk Inst., Copenhagen (Denmark). 1989. 101p. (In Danish). (CONF-8910517–: Information day on wood chip, and coal/wood chip fired district heating plants with flue gas condensing, Frederiksberg (Denmark), 31 Oct 1989). In *Information day on wood chip, and coal/wood chip fired district heating plants with flue gas condensing.* Order Number DE91763370. Source: OSTI; NTIS (US Sales Only).

A presentation of how a high content of moisture in wood fuels can promote more profitable and more efficient combustion resulting in a better fuel economy. (CLS).

14389 (NEI-DK–499, pp. 1-6) **Straw-firing.** Pedersen, V. (SEAS A/S (DK)). Dansk Automationsselskab, Lyngby (Denmark). 1990. 157p. (In Danish). (CONF-9002180–: Conference on decentral cogeneration plants and industrial heat and power production, Lyngby (Denmark), 28 Feb 1990). In *Decentral cogeneration plants and industrial heat and power production.* Order Number DE91763388. Source: OSTI; NTIS (US Sales Only).

In June 1986, the Danish government agreed that a number of decentral cogeneration plants should be established in the country, and that they should utilize domestically obtainable fuels, including straw. Experiments were carried out on a local cogeneration plant, formally fuelled with coal fines, to test the feasibility of using straw instead. Various methods of stoking were tried out in relation to straw in different forms (i.e. in bales, torn up, sliced etc.). These methods, and combustion conditions, are described. Investment costs for this project were 100 million Danish crowns, (for retrofitting - transmission network for district heating etc) and as the price of straw was also rather high the plant was operated at a very considerable loss. It is claimed that, because of this weak economical aspect the future development of local cogeneration plants fuelled with straw alone is no longer as high priority. (AB).

14390 (NEI-DK–499, pp. 1-17) **Gasification of straw.** Winther, E. (Elkraft A.m.b.A. (DK)). Dansk Automationsselskab,

Lyngby (Denmark). 1990. 157p. (In Danish). (CONF-9002180--: Conference on decentral cogeneration plants and industrial heat and power production, Lyngby (Denmark), 28 Feb 1990). In *Decentral cogeneration plants and industrial heat and power production.* Order Number DE91763388. Source: OSTI; NTIS (US Sales Only).

The 1986 government agreement on the development of decentral cogeneration plants (upto 450 MW) involves the production of 150 MW by three types of plant based on fuelling with either natural gas, straw or wastes. It has been generally claimed that fuelling with straw is too expensive, leads to corrosion and a low rate of production. The Danish electric power company ELKRAFT helped to finance and are helping to carry out four projects the aim of which is to test some innovative technologies in relation to straw-fired cogeneration plants in connection with pyrolysis. The current status of these projects is described in detail. (AB).

14391 (SV-UB--90-43) **Prestudy on wood fuel fired demonstration plants.** Westermark, M. Swedish State Power Board, Vaellingby (Sweden). 19 Oct 1990. 119p. (In Swedish). Order Number DE91763512. Source: OSTI; NTIS (US Sales Only).

The aim of this report is to identify technologies that within the range of 2-3 years will be most suitable for the production of electricity and electricity+heat from wood fuels. An evaluation of various factors speaks in favour of demonstration plants using a combined cycle, that is, different varieties of the combination gas turbine+steam boiler+steam turbine. The technically simplest fuel mix results when the gas turbine is driven solely with natural gas/LPG or oil and biofuel is used for auxiliary firing of the steam boiler (hybrid firing). For a given quantity of gas turbine+wood fuel, more electricity is obtained in a hybrid combined plant than if the fuels are processed in separate plants, for example, in a gas-fired combined cycle and a separate wood-fired steam cycle. The hybrid combined cycle with varying demands for cogenerated heat should therefore be competitive for base load operation. A usual connection alternative for a hybrid combined cycle is to use the gas turbine function as an air preheater for the steam boiler or as a preheater of feedwater for the steam boiler. If maximal thermal efficiency is desirable, optimal auxiliary firing in a solid fuel boiler in both connenction alternatives seems to correspond to 30-50% of the total fuel mix. The thermal efficiences of hybrid fired combined cycle amount to approximately 0.45 kW electricity/kW wood fuel in the condensing mode of operation. A suitable size should be approximately 40-100 MW wood fuel which, at base load operation, is equivalent to 200-600 GWh wood fuel/year. This size allows for reasonably short transport distances for the wood fuel, while making combined cycles with satisfactory performance technically feasible. (author).

0930 Economic, Industrial, and Business Aspects

Refer also to citation(s) 14373, 14374, 14383

14392 (SV-UB--90-40) **Inventory of the biofuel potential in southern Sweden.** Danielsson, B.O. (Swedish Univ. of Agricultural Sciences, Garpenberg (Sweden). Dept. of Operational Efficiency); Eriksson, Hillevi; Eriksson, Marianne. Swedish State Power Board, Vaellingby (Sweden). 18 Oct 1990. 198p. (In Swedish). Order Number DE91763550. Source: OSTI; NTIS (US Sales Only).

The objective was to describe the potential resources of wood for energy now and in the future, supply systems and how the wood fuels can be used on the energy market. It is an attempt to connect resources, technique and market into an overview showing where the wood fuels are best utilized. The forest conditions and the volume of logging residues are calculated for the next 70 years by a growth and cut model. Industrial by-products and other potential volumes are calculated as of today and for the near future, 10-20 years. The total energy use and the use of wood fuels is studied with projections of how and where the additional resources of wood fuels would fit into this market. The present use of wood fuels, 5.2 million m^3 solid, per year, can increase with about 8 million m^3 (15-20 TWh) per year. The main part of this volume comes from logging residues but also the amount of stem wood used as fuel is expected to increase. Changes of management practice will not affect the fuel volumes appreciabiy unless it implies that whole trees and not only the residues are used as fuel. Ecological restrictions have a more direct influence on the available volume but technical and methodological limits in harvesting operations will limit the possible increase to a maximum of 10-20%. Forest industries and private homes are large consumers today but they are not expected to further increase their use. One group of the present wood fuel users who can increase their consumption are district heating plants who are using 2 TWh of wood fuels per year and have a total need of around 12 TWh. This is not enough to accommodate the whole potential and unless cogeneration is introduced in larger scale the wood fuels have to find new markets. A potentially large market is substitution of fossil fuels for space heating and in industries. (authors).

0940 Transport, Handling, and Storage

Refer also to citation(s) 14372, 14392

14393 (STEV-EO--91-2) **Mobile equipment for briquetting of straw: Primary study.** Praks, O. (Swedish Univ. of Agricultural Sciences, Lund (SE). Dept. of Farm Buildings); Hadders, G. Statens Energiverk, Stockholm (Sweden); Swedish Univ. of Agricultural Sciences, Lund (Sweden). Dept. of Farm Buildings. 1990. 23p. (In Swedish). Project STEV-194-004. (SLU-LBT-S--4). Order Number DE91763560. Source: OSTI; NTIS (US Sales Only).

This report concerns a preliminary study of the possibility to develop a mobile system for the briquetting of straw. The system is intended to be moved from farm to farm and thus be able to support a large district with a convenient fuel derived from agricultural wastes. (U.W.).

0950 Environmental Aspects

Refer also to citation(s) 14747, 15262

14394 (JTI--116) **Converting short rotation forestry back into crop land.** Aakermo, R. Swedish Inst. of Agricultural Engineering, Uppsala (Sweden). Jun 1990. 56p. (In Swedish). Order Number DE91763536. Source: OSTI; NTIS (US Sales Only).

During 1989, the Swedish Institute of Agricultural Engineering (JTI) studied methods concerning the breaking up of energy forest plantations on arable land. The present report gives an account of the design, extent and accomplishment of the studies together with capacities and costs of the machinery and implements used in the studies. A survey of the literature on earlier such studies is given, together with a discussion of choice of method to use. The study was conducted at three different sites, and the experiments included a total of nine different approaches. The breaking up is divided into five main parts; rooting up the plantation; comminution of stumps and roots, levelling the surface; windrowing the stumps; collection of stumps; and levelling the surface after stump collection. Selection of a method for terminating energy forest production will be influenced by several factors, which may include for example, soil type and stoniness, subsequent land use, the farmer's access to suitable implements, and the cost level and labour input the farmer is prepared to accept. There is a need for further studies of methods of windrowing and collection of stumps. Not only are technological developments required but there is also a major need for reliable data for use in calculations of capacities and costs.

0980 Waste Management

14395 (ETSU-B--1241) **Review of waste preparation, handling and storage technology: Assessment of case histories and technology requirements.** Carr, M. (FEC Consultants Ltd., Oldham (UK)). AEA Environment and Energy, Harwell (UK). Energy Technology Div. 1990. 138p. Order Number DE91763836. Source: OSTI; NTIS (US Sales Only).

Work undertaken on combustion of Industrial and Commercial Wastes under the UK Department of Energy's Energy Efficiency Demonstration Scheme programme has shown up a number of shortcomings relating to the technology of fuel preparation. In particular, systems have been shown to have poor reliability, over-engineered or to be too costly, leading to the conclusion that there is considerable scope for improvement and a need to develop low

cost and more reliable systems. FEC Consultants Ltd., have been commissioned to carry out a review of current waste preparation, handling and storage technology, in order to assist in the determination of an R and D strategy aimed at promoting the development of reliable low cost systems for the utilisation of waste. This report covers an analysis of published case histories with particular reference to demonstration scheme projects, and an assessment of waste utilisation technology requirements. (author).

14396 (NEI-DK–502) **Selective removal of hydrogen sulphide in relation to biomass conversion plants: Pilot scale experiment with a gas cleaning system. Technical report.** Oestergaard, N. Ramboell og Hannemann Raadgivende Ingenioerer, Aarhus (Denmark). Nov 1990 84p. (In Danish). Contract TR-89.0171. Order Number DE91763400. Source: OSTI; NTIS (US Sales Only).

The purpose was to describe how to make selective absorption of hydrogene-sulfide in a pilot plant biogas scrubber, using $NaHCO_3$ or Na_2CO_3 bases. The main results were that $NaHCO_3$ is unqualified to absorb hydrogen sulfide, even at high Na^+ concentration, (this shows, that the Na^+ concentration has no influence on absorbtion of the sour gas), when using Na_2CO_3, the highest values of HS^- absorbed/Na^+ added are obtained at reaction times of about 6 hundreds of a second, and that, using this reaction time, the HS^- absorbed to Na^+ added is about 80 to 1000. The data shows that, using Na_2CO_3, the CO_2 absorption is below 0,6% points, whereas normal values of 3% points are obtained using NaOH. To absorb 75% of the hydrogen sulfide from a biogas containing 0,4%, expenditures are expected, per m^3 biogas, to be as follows. If using Na_2CO_3, the expenses would be about 0.20 DKR, when using NaOH, the expenses would be about 1.70 DKR, as long as the equivalents used equalize using Na_2CO_3, and when using NaOH, the expenses would be between 0.10 and 0.30 DKR, referring to values obtained from scrubber delivers. This discrepancy means, that the absorbed molar amount and gas per equivalent Na^+ added should be between 5.5 and 16.5 times higher using NaOH than using Na_2CO_3, referring to price of delivery. It is noted, that using very short columns af here, there may be problems concerning optimal liquid distribution in the column, which could affect the cost price using Na_2CO_3 negatively. (AB).

0990 Products and By-Products

14397 (NEI-DK–504) **Recycling of tar from gasification of biomass.** Cowiconsult Raadgivende Ingenioerer A/S, Virum (Denmark); Tarconord A/S, Nyborg (Denmark). Dec 1990 93p. (In Danish). Contract EM-1383/88-4. Order Number DE91763411. Source: OSTI; NTIS (US Sales Only).

The aim was to evaluate technological and economical potentials for developing a cracking process for converting tar, a by-product of biogas gasification, to gaseous products. As an alternative to tar-cracking, possibilities for processing tar so that this waste product could be used in connection with fluid fuel for motors, as a supplement to coking-plant tar, as a raw material for solvents and chemicals or as a medium for wood conservation were also investigated. Results signified that the re-use of tar was possible but involved complicated processing, and only small amounts of tar from the gasification of biomass were reckoned to be available in Denmark within the next 15 years. Tar production, processing and applications are described in detail. (AB).

10 SYNTHETIC FUELS

1002 Production

Refer also to citation(s) 14958

14398 (CONF-900828–11) **Synthesis of methanol in a methanol-rich liquid phase.** Liu, Z.; Palekar, V.; Tierney, J.W.; Wender, I.; Shah, Y.T. Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering. 9 Jul 1990. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89786 ;FG22-84PC71257. From 1990 summer national meeting of the American Institute of Chemical Engineers (AIChE); San Diego, CA (USA); 19-22 Aug 1990. Order Number DE91009810. Source: OSTI; NTIS; GPO Dep.

A novel method for synthesizing methanol from CO and H_2 in a slurry reactor is described and experimental results are presented. At the temperatures and pressures used (100-160°C, 50 atm) the methanol product is liquid and constitutes the bulk of the liquid phase. Small amounts of methyl formate (4 to 5%) and other products (less than 1% total) are formed. A heterogeneous catalyst (copper chromite) and a homogeneous catalyst (an alkali salt) are used in a single reactor. It appears likely that the reaction proceeds in two steps - carbonylation of methanol to methyl formate and then hydrogenation of the formate to two moles of methanol. Experiments were carried out in a 300 ml autoclave with continuous gas feed and intermittent liquid withdrawal. In situ reduction of the copper chromite was found to be as effective as external reduction and was used in all runs. A barium-promoted copper chromite showed substantially less deactivation than a manganese promoted one. Of six homogeneous catalysts tested the most effective was potassium methoxide, although some reaction occurred with all the homogeneous catalysts used. The rate of reaction was found to vary with gas feed rate - an unexpected result. It is proposed that this is due to the presence of small amounts of an inhibiting agent which accumulates in the liquid at low flow rates. 7 refs., 2 tabs.

14399 (DOE/PC/89786–T1) **A novel process for methanol synthesis: Progress report, June 1, 1990–August 31, 1990.** Tierney, J.W.; Wender, I. Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering. [1990]. 23p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-89PC89786 ;FG22-84PC71257. Order Number DE91009808. Source: OSTI; NTIS; GPO Dep.

A bench-scale reactor is being used to conduct studies of the conversion of synthesis gas to methanol by a novel process. During the last quarter, the authors investigated the effect of various catalysts on the rate of MeOH synthesis. The success of salts such as alkali formates and carbonates as catalysts indicates the regeneration of the homogeneous catalyst in the presence of Cu-chromite. This could also explain the increased tolerance of the process to the presence of small amounts of H_2O. Mathematical equations were written to explain the non-linearity of the rate (in gmoles/min) with catalyst concentration and the effect of feed flow rate. An on-line gas sampling valve was installed. Efforts are continuing to install an on-line liquid sampling valve. A major difficulty is due to the fact that liquid flow is not continuous. 6 refs., 7 figs., 2 tabs.

14400 (DOE/PC/90305–T1) **Probe molecule studies: Active species in alcohol synthesis: First quarterly report, September 1990–December 1990.** Blackmond, D.G.; Wender, I. Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering. Jan 1991. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-90PC90305. Order Number DE91008533. Source: OSTI; NTIS; GPO Dep.

The goal of this research is to develop a better understanding of the mechanisms of oxygenate formation from syngas over supported catalyst by in-situ addition of probe molecules. Alteration of the reaction pathways by probe molecule addition will be observed and analyzed to reveal mechanistic information. A reaction and analysis system capable of carrying out the experiments for the proposed research has been set up and will be used to run CO/H_2 reactions in both the presence and the absence of each probe molecule under conditions which favor the formation of oxygenated products. Rh and/or Co, which are known to produce oxygenates from syngas, with SiO_2 as support will be prepared and characterized for this study. Analysis and studies of our experimental results are expected to provide us enough information to propose mechanistic hypothesis of the oxygenates formation from CO/H_2 and probably suggest novel ideas for design of highly reactive/selective catalysts and even synthesis processes.

13 HYDRO ENERGY

1303 Plant Design and Operation

14401 (ETSU-SSH–4053) **Component performance evaluation of a pneumatic low-head hydro device.** AEA Environment and Energy, Harwell (UK). Energy Technology Div. 1990. 79p. Contract E/5A/CON/4053/1526. Order Number DE91763838. Source: OSTI; NTIS (US Sales Only).

This Report covers work by Hydro Energy Associates Ltd and Coventry Polytechnic Energy Systems Group under an Agreement with the UK Department of Energy. The Agreement provided for experimental measurements to be made during commissioning of a demonstration 150 kW output pneumatic low-head hydro-electric plant on the River Derwent, so that subsequently it would be possible to make a thorough component performance evaluation and a proper comparison with the original design specification and mathematical modelling predictions. The main areas of investigation under the Agreement were the operational characteristics and stress cycle of the flexible membrane, the detailed performance characteristics and scaling laws of a large Wells turbine operating above the critical Reynolds number and the optimisation of operational control strategies for an oscillating air-water hydro-electric device. The assessment of the overall performance and output of the device has been limited by problems mainly with the flexible membrane, but also with the turbine. The parts of the programme which were possible to complete are reported together with information on the membrane and turbine derived from the commissioning process. (author).

1305 Economic, Industrial and Business Aspects

14402 (ETSU-SSH–4073) **Small-scale hydro power study of non-technical barriers.** AEA Environment and Energy, Harwell (UK). Energy Technology Div.; MRM Partnership, Bristol (UK). 1990. 75p. Order Number DE91763839. Source: OSTI; NTIS (US Sales Only).

The objectives of the study reported here were: (i) to identify all real and perceived non-technical barriers and their effects on the exploitation and commercial development of small scale hydro power projects in the UK; (ii) to determine ways in which such barriers might be overcome; (iii) to assess the effects that the removal of water abstraction charges and the introduction of formula rating might have on hydro power development, using hypothetical case studies as appropriate. (author).

1306 Environmental Aspects

Refer also to citation(s) 15290, 15291, 15333, 15335

14403 (DOE/BP/16475–1) **South Fork Clearwater River habitat enhancement: Crooked and Red Rivers: Annual report, 1989.** Baer, W.H.; Wadsworth, T.K.; Clarkin, K.; Anderson, K. Forest Service, WY (USA). Nez Perce National Forest. Jan 1990. 54p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AI79-84BP16475. Order Number DE91009785. Source: OSTI; NTIS; GPO Dep.

In 1983, the Nez Perce National Forest and the Bonneville Power Administration entered into an interagency agreement to enhance and improve habitat for two anadromous fish species, spring chinook salmon (Oncorhynchus tshawyscha) and summer steelhead trout (Onchorhyncus mykiss), in the South Fork Clearwater River tributaries. The South Fork Clearwater River was dammed in 1927 for hydroelectric development. Anadromous fish runs were virtually eliminated until the dam was removed in 1962. To complicate the problem, upstream spawning and rearing habitats were severely impacted by dredge and hydraulic mining, road building, timber harvest, and over-grazing. Fish habitat improvement projects under the above contract are being carried out in two major tributaries to the South Fork Clearwater River. Both the Red River and the Crooked River projects began in 1983 and will be completed in 1990. 12 figures., 1 tab.

14404 (DOE/BP/64321–2) **Camas Creek (Meyers Cove) anadromous species habitat improvement: Annual report, 1989.** Hardy, T.; Andrews, J. Forest Service, Salmon, ID (USA). Salmon National Forest. Mar 1991. 42p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AI79-86BP64321. Order Number DE91009705. Source: OSTI; NTIS; GPO Dep.

Historical agricultural practices and natural events contributed to severe degradation of riparian zones and instream fish habitat in the Meyers Cove area of Camas Creek. In 1984, Salmon National Forest personnel began implementing specific management activities in riparian areas and the stream channel to accelerate habitat recovery. In 1987–88, 4.3 miles of fence was constructed establishing a riparian livestock exclosure in the Meyers Cove area of Camas Creek. One end-gap and two water-crossing corridors were constructed in 1989 to complete the fence system. The riparian exclosure has been fertilized with phosphorous-rich fertilizer to promote root growth. A stream crossing ford was stabilized with angular cobble. Streambank stabilization/habitat cover work was completed at three sites and three additional habitat structures were placed. Extensive habitat inventories were completed to identify quality/quantity of habitat available to anadromous fish. The work accomplished was designed to promote natural revegetation of the riparian area to improve rearing habitat cover and streambank stability. Streambank work was limited to extremely unstable sites. Enhancement activities will improve spawning, incubation, and rearing habitat for wild populations of steelhead trout and chinook salmon. Anadromous species population increases resulting from these enhancement activities will provide partial compensation for downstream losses resulting from hydroelectric developments on the Columbia River system. 9 refs., 6 figs., 7 tabs.

1307 Power-Conversion Systems

14405 (DOE/BP/24332–1) **Control aspects of the brushless doubly-fed machine: Final report.** Lauw, H.K.; Krishnan, S. Oregon State Univ., Corvallis, OR (USA). Dept. of Electrical and Computer Engineering. Sep 1990. 79p. Sponsored by USDOE, Washington, DC (USA). DOE Contract BI79-85BP24332. Order Number DE91009707. Source: OSTI; NTIS; GPO Dep.

This report covers the investigations into the control aspects of a variable-speed generation (VSG) system using a brushless doubly-fed generator excited by a series-resonant converter. The brushless double-fed machine comprises two sets of stator 3-phase systems which are designed with common windings. The rotor is a cage rotor resembling the low-cost and robust squirrel cage of a conventional induction machine. The system was actually designed and set up in the Energy Laboratory of the Department of Electrical and Computer Engineering at Oregon State University. The series-resonant converter designed to achieve effective control for variable-speed generation with the brushless doubly-fed generator was adequate in terms of required time response and regulation as well as in providing for adequate power quality. The three elements of the VSG controller, i.e., voltage or reactive power controller, the efficiency maximizer and the stabilizer, could be designed using conventional microprocessor elements with a processing time well within the time period required for sampling the variables involved with executing the control tasks. The report treats in detail the stability problem encountered in running the machine at certain speed regions, even if requirements for steady-state stability are satisfied. In this unstable region, shut down of the VSG system is necessary unless proper stabilization controls are provided for. The associated measures to be taken are presented. 10 refs., 24 figs.

14 SOLAR ENERGY

14406 (EUR–12740) **Nonnuclear energies: European Working Group on Solar Thermal Plant Monitoring: Proceedings of the 1st and 2nd meeting.** Aranovitch, E. (Commission of the European Communities, Ispra (Italy). Joint Research Centre); Gilliaert, D. (eds.); Buscarlet, C.; Filloux, A. (eds.). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Commission of the European Communities, Ispra (Italy). Joint Research Centre. 1990. 228p. Sponsored by Commission of the

European Communities, Brussels (Belgium). (CONF-8901216–Summ.: 1. meeting of the European working group on solar thermal plant monitoring; 2. meeting of the European working group on solar thermal plant monitoring, Ispra (Italy); Ispra (Italy), 26 Jan 1989; 21-22 sep 1989; CONF-8909406–). Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

In the past ten years, the Commission of the European Communities has supported in the field of solar technology numerous Demonstration Programmes, directed by the Directorate General for Energy, DG XVII. In order to demonstrate the applicability of these new techniques, it is of crucial importance to monitor their performance. Therefore, the Contractor of a Demonstration Project is responsible for the monitoring campaign, which has to cover a time period of at least two years. Monitoring solar thermal systems is not an easy task and requires knowledge of sensors, data handling, appropriate analysis, and finally presentation of results in an understandable form. For most of the Contractors involved, this is a new field of activity which requires an assistance often difficult to find. In order to resolve this situation, the CEC Joint Research Centre of Ispra, within the frame of a collaboration with CEC-DG XVII, has set up a working group which will issue documents such as Format Sheets and organize meetings to simulate the exchange of experience at EC level. The first meeting concluded with the recommendation that a main effort should be made at descriptions of the projects, guidelines for monitoring; and guidelines for evaluation. Two papers were presented on solar demonstration projects and examples of the problems to be encountered. At the second meeting status reports were given on the work done on Format Sheets, evaluation and monitoring philosophy; and technical aspects of monitoring. Some papers have been indexed separately for inclusion on the data.

14407 (STEV-SOL–91-2) **SERC progress report 1990.** Solar Energy Research Center, Borlaenge (Sweden); Statens Energiverk, Stockholm (Sweden). Jan 1990. 60p. Project STEV-656-053. (SERC-UCFB–90-0029). Order Number DE91763555. Source: OSTI; NTIS (US Sales Only).

The Solar Energy Research Center is a separate entity within the Faculty of Engineering, University College of Falun/Borlaenge. SERC has previously published three biennal Progress Reports, covering activities up to 1988 and plans for 1989. A need for more frequent summing up is however felt, and thus the present Progress Report 1990 is our first annual progress report. It describes publications and important events during 1989 - for the period prior to 1989 see earlier progress reports. Furthermore, it presents projects current and planned in January 1990. The Center has been engaged in the following activities: * Research and development in the field of solar energy with special emphasis on applied optics, solar heating, computer simulations and solar energy for development. * University level teaching and student thesis work supervision in the field of solar energy. * Facilitate information from solar energy specialists to the regions companies as well as the general public by means of seminars, exhibitions, popular articles, press conferences, radio/TV-programs and by building up a solar energy library. * Establish national and international contacts in order to enhance the knowledge of solar energy, regionally as well as nationally and internationally.

1403 Economic, Industrial, and Business Aspects

14408 (DOE/EIA–0174(89)) **Solar collector manufacturing activity, 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. Mar 1991. 47p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009827. Source: OSTI; NTIS; GPO; GPO Dep.

This report presents a statistical profile of the solar thermal collector and the photovoltaic module manufacturing industries during 1989. The profile includes information on the number of manufacturers and importers; the amount and value of solar collector and photovoltaic module shipments by type of collector; market sector and end-use information; and employment and product information. This report for the first time includes an accounting of the manufacture and shipments of parabolic trough collectors used by independent power producers to generate electricity for the electric grid. However, only total shipment data are reported to avoid disclosure of company-specific information. The statistics on the shipments of collectors for this use have been assembled for the 1984–1989 period and are included in the information on solar thermal collector shipments presented in this report. Appendices explain survey methodology and survey questionnaires, and list respondents to both surveys. 20 tabs.

1404 Environmental Aspects

14409 (BFR-T–21-90) **Environmental consequences of the use of new energy technology: Solar heating, heat storage, heat pumps.** Svensson, Torbjoern (Chalmers Univ. of Tech., Goeteborg (SE)). Swedish Council for Building Research, Stockholm (Sweden). 1990. 86p. (In Swedish). Order Number DE91763544. Source: OSTI; NTIS (US Sales Only).

Environmental effects of the use of solar heating, heat storage and heat pumps for space heating are discussed. As a general conclusion it is noted that the new technology gives less environmental consequences than traditional, specially if a substitution of CFCs is realized. (L.E.).

1405 Solar Energy Conversion

Refer also to citation(s) 14367, 15209, 15810

14410 (IS-T–1490) **Excited state structure, energy and electron transfer dynamics of photosynthetic reaction centers: A hole burning study.** Tang, De-Ming. Ames Lab., IA (USA). 22 Mar 1991. 254p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-82. Order Number DE91010181. Source: OSTI; NTIS; GPO Dep.

The excited state structure, early time energy and electron transfer dynamics for bacterial photosynthetic reaction center of Rhodoseudomonas viridis, Rhodobacter sphaeroides and green plant photosynthetic reaction center of Photosystem 2 (PS 2) have been determined by hole burning spectroscopy. Transient hole burned spectra of the bacterial reaction centers reveal a special pair Franck-Condon marker mode progression with a superimposed zero phonon hole. Such progression is found to be absent in green plant Photosystem 2 which raises the question of structural similarities between the PS 2 and bacterial reaction centers. The excited state decay times are obtained for all systems and found to be consistent with time domain experiments. Similar temperature dependence of the decay kinetics have been observed for both bacterial and PS 2 reaction centers. Study of different preparations of reaction center of Photosystem 2 utilizing hole burning spectroscopy indicates that Triton X-100 detergent significantly affect the absorption and persistent hole burned spectra and disrupts the energy transfer from the accessory chlorophyll to the active pheophytin. The comparison between the bacterial reaction centers and Photosystem 2 has been presented and discussed in order to understand the difference in their early time dynamics and the excited state structure. A theoretical model has been developed based on the principle of linear electron-phonon coupling and imhomogeneous broadening. Our experimental results are found to be in good agreement with the theoretical calculations. 335 refs., 43 figs.

14411 (LBL–30077) **Structural studies of manganese and halide in the photosynthetic oxygen evolving complex.** DeRose, V.J. Lawrence Berkeley Lab., CA (USA). Oct 1990. 214p. Sponsored by USDOE, Washington, DC (USA); National Science Foundation, Washington, DC (USA). DOE Contract AC03-76SF00098. Grant DMB 88-04526. Order Number DE91009071. Source: OSTI; NTIS; GPO Dep.

Electron paramagnetic resonance (EPR) and x-ray absorption spectroscopy (XAS) were used as probes of the manganese atoms of the oxygen evolving complex (OEC). XAS studies at liquid helium temperatures allowed the observation of a scatterer at >3 Å from the absorbing manganese. Extended x-ray absorption fine structure (EXAFS) data taken on preparations from both spinach and the thermophilic cyanobacterium Synechococcus sp. fit to nearly identical parameters. By comparison with model compounds the scatterer at >3 Å fits well to a single manganese-manganese

distance per the four manganese in the OEC cluster. The correlation between fluoride inhibition of oxygen evolution activity and enhancement of the g = 4 EPR signal which arises from the OEC in the S_2 state was ascertained. The narrowing of the EPR signal is interpreted as being due to fluoride binding to the manganese. A damping of the scattering due to manganese at 2.7 Å was observed in data from the fluoride-treated preparations poised in the S_2 state. EXAFS of bromide-substituted PSII preparations from Synechococcus showed no change relative to EXAFS of chloride-containing samples. The substructure observed by high resolution EPR of the S_2-state multiline signal also shows no change in the presence of bromide. These results argue strongly against the presence of a halide ligand bridging the manganese in the OEC, but do not exclude a single terminal halide ligand. Electron spin echo spectroscopy of ^{15}N-containing preparations from Synechococcus identify nuclear envelope modulation due to nitrogen near the manganese of the OEC. The modulation frequency is consistent with its arising from an amino acid ligand such as a histidine. 197 refs., 51 figs., 12 tabs.

14412 (SAND–90-2164C) **PV concentrators today and tomorrow.** Maish, A.B.; Chamberlin, J.L. Sandia National Labs., Albuquerque, NM (USA). [1991]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910425–1: 10. European photovoltaic solar energy conference and exhibition, Lisbon (Portugal), 8-12 Apr 1991). Order Number DE91010577. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy's photovoltaic concentrator cell and module development program has expanded with the commencement of a significant program jointly funded with four cell and four system manufacturers. This paper reviews the status of crystalline silicon, III-V cell and concentrator module research, with emphasis being given to activities by participants in the DOE program. Also covered is a summary of the fundamental reason for pursuing the concentrator option, namely the high probability of achieving efficiency and cost targets necessary to meet competitive energy cost goals. 10 refs., 4 figs.

14413 (SERI/TP–212-3675, pp. 26-111) **Amorphous silicon research.** Crandall, R.; Branz, H.; Carapella, J.; Langford, A.; Mahan, H.; McMahon, T.; Nelson, B.; Sadlon, K.; Tsuo, S.; Baker, D.; Salamon, S.; Fleet, M.; Deng, X.; Galliano, R.; Xu, Y.; Williamson, D. Solar Energy Research Inst., Golden, CO (USA). Sep 1990. In *Solid State Photovoltaic Research Branch. Annual report, FY 1989.* 289p. Order Number DE91002128. Source: OSTI; NTIS.

The extensive work on microstructure carried out at SERI in the past was based on inferences of microstructure from infrared absorption and band tail broadening. This year, the authors were successful in making small angle x-ray scattering (SAXS) measurements on a-Si:H that were two or three orders of magnitude more sensitive than any previous measurements, permitting the first determination of the microstructure in device quality a-Si:H. A new trap spectroscopy technique was developed that allows one to determine the distribution of trapped holes in valence band tail states. These states are particularly important because they are instrumental in determining photoconductivity. The effort on devices produced a new processing step using a hydrogen plasma to improve photovoltaic efficiency, and they are now making tandem cells from a-Si:H in preparation for fabricating a-Si:H amorphous germanium tandem cells. A significant portion of this effort is devoted to the light-induced metastabilities or Staebler-Wronski effect. They have gained considerable understanding of this effect and have developed new models that are in much better agreement with experiment than are existing ones. A brief account of some of the achievements of the Amorphous Silicon Research Group follows.

14414 (SERI/TP–212-3675, pp. 112-203) **Polycrystalline thin films.** Noufi, R.; Albin, D.; Pern, F.J.; Tuttle, J.; Dolan, J.; Carapella, J. Solar Energy Research Inst., Golden, CO (USA). Sep 1990. In *Solid State Photovoltaic Research Branch. Annual report, FY 1989.* 289p. Order Number DE91002128. Source: OSTI; NTIS.

The primary goals are (1) to increase the understanding of materials processes; (2) to increase the understanding of materials and their properties that are critical to device performance; (3) to investigate a low-cost, large-area fabrication process, such as electrodeposition; and (4) to help to solve fundamental problems that will help the $CuInSe_2$ technology become viable. The task entails the fabrication and characterization of thin films and photovoltaic devices of ternary and quaternary semiconductor materials. The approach is to study the fundamental properties of the material and relate these properties to photovoltaic applications. The material of emphasis is $CuInSe_2$ polycrystalline thin films. Other materials such as $CuGaSe_2$ are studied for use in conjunction with $CuInSe_2$. The authors identify and study those fundamental material properties crucial to the performance of the device, such as stoichiometry and defect chemistry of the films; effect of composition and annealing treatment on the fundamental properties; modification of the physical and chemical properties of the films to achieve better device performance parameters, especially open circuit voltage (V_{oc}); feasibility to bring tile electrodeposition of $CuInSe_2$ as a low-cost, large-area process to state of the art. The expected results are a comprehensive data base and a better understanding of the properties of $CuInSe_2$ and $CuGaSe_2$ polycrystalline thin films that are critical to the device performance; the use of the above studies to effect improved device parameters, especially V_{oc}(0.5-0.6 V); the demonstration of $CuInSe_2$ electrodeposition as a low-cost, large-area process to produce state-of-the-art CdS/$CuInSe_2$ devices; and the demonstration that the program-total results have contributed to the advancement of the $CuInSe_2$ technology. 89 refs.

14415 (SERI/TP–212-3675, pp. 204-239) **III-V high-efficiency photovoltaic cells.** Olson, J.M.; Beck, E.E.; Blakeslee, A.E.; Kibbler, A.E.; Kurtz, S.R.; Faine, P.J.M. Solar Energy Research Inst., Golden, CO (USA). Sep 1990. In *Solid State Photovoltaic Research Branch. Annual report, FY 1989.* 289p. Order Number DE91002128. Source: OSTI; NTIS.

The objective of this work is to develop an understanding of, and solutions to, the problems inherent in the fabrication of high-efficiency, multijunction cascade solar cells using such III-V semiconductor materials as GaAs, GaP, InP, GaInP, and AlGaAs. The major areas of research include metal-organic chemical vapor deposition (MOCVD), material analysis, and device fabrication and characterization. Most of the past year's work has been directed toward the development of the lattice- and current-matched $Ga_{0.5}In_{0.5}P$/GaAs cascade solar cell. This cell has a one-sun, air-mass (AM) 1.5 theoretical efficiency of 34%, but exhibits few of the problems typical of lattice-mismatched heterostructures. Progress and highlights in this area are presented and discussed.

14416 (SERI/TP–212-3675, pp. 269-282) **Laser Raman and luminescence spectroscopy.** Mascarenhas, A. Solar Energy Research Inst., Golden, CO (USA). Sep 1990. In *Solid State Photovoltaic Research Branch. Annual report, FY 1989.* 289p. Order Number DE91002128. Source: OSTI; NTIS.

The primary objective of this research is to understand the opto-electronic properties of solid-state materials used for solar cell applications by studying their radiative recombination mechanisms. The principal technique we have utilized for elucidating such information is low-temperature photoluminescence. These experiments, combined with polarization studies, enable the selection rules for the optical transitions to be determined and thereby provide crucial information about the intrinsic electronic band structure exhibited by photovoltaic materials. The opto-electronic properties manifested are determined by the final structure and bonding achieved in the materials grown for photovoltaic applications. A direct probe of the lattice structure is possible through Raman scattering spectroscopy. Raman scattering studies enable the determination of the normal vibrational mode frequencies and their symmetries. This provides useful clues about the dynamic behavior of the lattice structure, its bonding, and its symmetry. In the past three years, we have exploited the above-mentioned spectroscopic techniques to investigate the microcrystalline behavior of amorphous semiconductors and the role of phonons in high-$T_c$superconductivity. During the past year, we have focused our attention on spontaneous ordering and lattice dynamics.

14417 (SERI/TP–212-3675, pp. 240-268) **Solid-state theory.** Zunger, A.; Wood, D.M.; Froyen, S.; Wei, S.H.; Dandrea, R.; Lu, Z.W.; Bernard, J.E. Solar Energy Research Inst., Golden, CO (USA). Sep 1990. In *Solid State Photovoltaic Research Branch. Annual report, FY 1989.* 289p. Order Number DE91002128. Source: OSTI; NTIS.

The primary mission of the solid-state theory research effort is to (1) bring state-of-the-art methods and ideas of condensed matter theory into the realm of photovoltaic materials, and thus (2) develop a fundamental understanding of the elements that constitute and enhance solar cell performance, and (3) use this knowledge to design novel photovoltaic materials that could be grown and tested in the laboratory by modern crystal growth techniques. The second mission is to analyze the properties of existing materials. Unlike simple devices (e.g., the transistor), the underlying complexity of solar cells in terms of their chemical constitution, diverse atomic structures, defects, interfaces, and varying degrees of order leads to a dependence of their performance (e.g., efficiency) on a very large number of material parameters that are difficult to disentangle and isolate. Solid-state theory research attempts to address these problems by modeling the electronic structure of prototype systems that isolate these effects. This report summarizes work in FY 1989 in the following areas: Stability and band offsets of heterovalent superlattices Si/GaP, Ge/GaAs, and Si/GaAs; Temperature-composition phase diagrams of bulk GaInP, AlGaAs, and GaAsSb; Structures, thermodynamics, and optical properties of epitaxial alloys; Stability of strain layer superlattices; Electronic structure of H_2 in palladium: can solid-state effects explain cold fusion? Ordering in semiconductor alloys; and Band structure of random alloys.

14418 (SERI/TP–214-4141) **Optimization of transparent and reflecting electrodes for amorphous silicon solar cells: Annual subcontract report, 1 October 1989–30 September 1990.** Gordon, R.G. (Harvard Univ., Cambridge, MA (USA). Dept. of Chemistry); Hu, Jianhua; Musher, J.; Giunta, C. Solar Energy Research Inst., Golden, CO (USA); Harvard Univ., Cambridge, MA (USA). Dept. of Chemistry. Feb 1991. 44p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-83CH10093. Order Number DE91002132. Source: OSTI; NTIS; GPO Dep.

The specific objectives of this research are to: (1) Deposit and characterize textured zinc oxide with improved conductivities (less than 8 ohms/square sheet resistance) and optical transmission (greater than 85% for 450 to 700 nm), for use as front and back contacts in hydrogenated amorphous silicon p-i-n devices. Study the surface morphology of zinc oxide films deposited by chemical vapor deposition at atmospheric pressure (APCVD), their crystallite sizes, shapes and orientations, and their nucleation (early growth) as a function of chemical precursors and reaction conditions. Optimize the growth process to produce structures that provide good light trapping in an amorphous silicon film deposited on the zinc oxide film. The films must have good adhesion to glass substrates. (2) Study the deposition rate of zinc oxide films as a function of temperature, and concentration and types of reactants. Maximize the growth rate, subject to the conditions of maintaining satisfactory film properties, including high transparency (85%), high conductivity (8 ohm/square sheet resistance), and good light trapping. (3) Develop techniques for deposition of fluorinated zinc oxide films by APCVD on amorphous silicon films in the temperature range of 250-280C for use as back contacts. (4) Deposit titanium nitride films at a temperature of about 250C by APCVD on amorphous silicon as diffusion barrier, and then deposit highly reflective metals such as aluminum or silver. Anneal samples and test for metal diffusion through the TiN into the silicon. Optimize the TiN film for minimum diffusion consistent with maintaining desirable TiN film properties. (5) Incorporate the front and back contacts including the TiN barrier layer developed under this research into amorphous silicon p-i-n devices and determine the film parameters that provide the greatest improvement in the device solar energy conversion efficiency. 23 refs., 18 figs., 2 tabs.

1406 Photovoltaic Power Systems

14419 (ENET–8900094/2) **3 kW pilot and demonstration plant: Final report.** Clavadetscher, L.; Meier, F.; Nordmann, T. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1990. 21p. (In German). Order Number DE91765859. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

With the fitting of instruments for the 3 kW pilot plant, the necessary specialist knowledge in measuring technology for photo-voltaic installations has been acquired. This can therefore be regarded as a kind of training field for a set of measuring instruments. The aim of the project was to develop just such a set of measuring instruments and to test them in practice. At the beginning of November 1989, TNC started up the 100 kW Felsberg/Domat-Ems combined network system. A photo-voltaic system of this size requires, for monitoring and measuring purposes, a tried and tested and operational set of measuring instruments. The project comprises the construction and operation of a 3 kW photo-voltaic combined network system, the testing of automatic data acquisition, the testing of data-telecommunication via the public telephone network and the administration and analysis of the test data using a personal computer. 15 figs., 5 tabs., 7 refs.

14420 (ENET–8990021/1) **INFOSOLAR annual report 1989.** Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1990. 64p. (In DE,FR,IT). Order Number DE91765817. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

There are reports about the activities of the Consultancy and Documentation Office for Solar Energy, other new forms of energy and on energy saving, which have been conducted during 1989 at the four branch offices in Brugg, Taenikon, Colombier and Bellinzona. The range of activities embraced the fields of active and passive solar energy, photo-voltaics, heat pumps, energy saving and miscellaneous matters (biogas, wood, wind etc.). figs., tabs., refs.

14421 (EUR–12750) **Photovoltaic solar current generator to supply an early-warning system for forest fires: Demonstration project: Final report.** Fonzi, F. (Italenergie SpA, Sulmona (Italy)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Italenergie SpA, Sulmona (Italy). 1990. 37p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract No. SE/123/83 IT. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The objective was to design a photovoltaic current generator that would be able to feed electrical energy to an early warning system for forest fires. The complete system includes the following main components: photovoltaic current generator; electrical energy storage batteries; optical and infrared telecamera; data elaboration unit; data recording; transmitter and receiver unit; and monitor and control computer. The system can cover an average of about 300 Km^2 of forest. The report describes the site selected, system installation, problems encountered, costs, and system operation and performance results. 2 figs., 3 tabs.

14422 (EUR–12755) **Programme of rural electrification by photovoltaic generators: Demonstration project: Final report.** Coroller, P. (Agence Francaise pour la Maitrise de l'Energie, 06 - Valbonne (France)); Aubert, B. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Agence Francaise pour la Maitrise de l'Energie, 06 - Valbonne (France). 1990. 92p. (In English, French). Sponsored by Commission of the European Communities, Brussels (Belgium). Contract No. SE/466/83 FR. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The aim of this program is to demonstrate that in situ electricity production by photocells provides an advantageous technical and economic option for dwellings not linked to the centralized mains when restrictions such as distance and environment make conventional electrification unsuitable. This kind of situation is found in the South of France and more generally in Southern European countries: Spain, Portugal, Italy, Greece, etc. The project enabled installing in isolated permanent dwellings 40 generators of standardized power chosen from a range of 400 Wp, 800 Wp, 1200 Wp and 1500 Wp. Thus it was possible to demonstrate the viability of this type of electrification on a significant scale and explore its different aspects: on the technical level: realization of reliable, standardized easy-to-use systems; on the economic level: competitiveness of the photovoltaic solution compared to competing energy sources (mains, generator sets, etc.); on the sociological level: improvement of user comfort through the provision of a satisfactory service; and on the administrative level: setting up new procedures

between users and the institutional organizations involved. The instrumentation installed on all generators and more detailed measuring operations enabled program technical monitoring. Questionnaire surveys gave indications as to user satisfaction. The paper describes the site; the construction, installation, and commissioning; operation; results; and economic viability. 16 figs., 4 tabs.

14423 **Solar generator.** Stein, K.-U. 24 Jul 1990. Filed date 8 Dec 1989. Canada Patent patent application 2004980. 27p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

Known solar generators using semiconductor solar cells have flat plates for the acceptance of the cells, and a number of masts for holding the plates are arranged in a tower-like structure and connected to a sun tracking device. In such devices, the technique for tracking the sun is involved and susceptible to disturbances, and the required masts add to the cost and complexity of the device. An object of this invention is to provide a solar generator that is cost efficient and simple in structure. According to the invention, the solar cells are held in cable bracing, and the cables are interlaced and form an angle of less than 90° with the horizon. The cable bracing is also used for carrying current generated in the solar cell equipment. Within the cable bracing, the solar cell equipment is arranged according to a checkerboard pattern so that stability in wind is improved and sunlight can pass underneath the solar cell equipment to promote plant growth. 24 figs.

14424 **Frame for solar cell devices.** Stein, K.-U.; Cammerer, F. 24 Jul 1990. Filed date 8 Dec 1989. Canada Patent patent application 2004981. 15p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

An object of this invention is to provide solar cell equipment including a frame that can carry the current generated in the equipment. The cross-section of the frame of this invention can be designed to be adequately large, and can thus easily pick up high electrical currents that may be generated. The invention reduces the number of interconnections needed within each solar cell module. Individual solar cell devices can be directly interconnected to one another. A simple structure of parallel and/or series circuits of solar cell devices may be realized. Devices that include an individual solar cell or solar cell module that can be provided with frame means can be employed as the solar cell equipment in this invention. The frame is usually constructed of aluminum or steel members, may be sealed with silicone, and may be composed of a combination of metal and an electrically conductive plastic. For optimum performance, the solar cell equipment is mechanically stabilized with the assistance of glass panes or glass fibers. The electrical connections between solar cells or connections between a solar cell and the frame can be formed with electrically conductive foils, metallizations, or plastic. Such connections can be produced by employing printed circuit board technology. Solar cell equipment including a frame of this invention can be framed on 2 sides, on all sides, or at only parts of its edges. Various electrically conductive frame parts may be separated by electrically insulating frame parts. 7 figs.

14425 **Solar cell device.** Cammerer, F.; Bednorz, K.; Riermeier, M. 24 Jul 1990. Filed date 11 Dec 1989. Canada Patent patent application 2005153. 18p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

An object of this invention is to provide a solar cell equipment that enables a simple assembly, while obviating the need for a complete solar cell frame. This object is achieved by mounting solar cell equipment using clamps of this invention. The clamps enable a single mounting which may be employed in conjunction with a frame. The clamps provide electrical contact to the solar cell equipment for carrying the solar generated current. Clamps may also be completely insulated from the solar cell equipment. The clamps provide mechanical stabilization for the solar cell equipment. This invention is particularly useful for frameless solar cell equipment because the outlay for material and additional costs can be eliminated. 9 figs.

1407 Solar Thermal Power Systems

14426 (EUR–12754) **Heating of a large industrial building with solar air-collectors in comparison with a conventionally heated building: Demonstration project: Final report.** Barthel, V. (Grammer (W.) KG, Amberg (Germany, F.R.)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Grammer (W.) KG, Amberg (Germany, F.R.). 1990. 45p. (In German, English). Sponsored by Commission of the European Communities, Brussels (Belgium). Contract SE 136/84 DE. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 5.

The general aim was the proof of saving heating energy by using solar energy. The first partial aim was to reach the saving of heating energy directly, that means without the till now customary transformation to hot-water and from hot-water to room-air but directly with solar hot-air production in the air/air-system. Working without intermediate heat transfer mediums facilitates the exploitation of low solar temperatures already a few degrees above room temperature, while at the same time the system itself is not complicated. The second partial aim was to furnish proof of the fact, that the conventional saving of fuel is much higher than the produced amount of solar energy. This observation has been made over years for several plants but the results have always been doubted for lack of time-, place- and use-identity. Because of two nearly equally constructed and equally used halls (purchasing/sales warehouse) at the same location a proof of this was also to be found within the project. The third partial aim was the description of the costs. Costs for additional air distributing- and air ventilation systems are allotted because bigger halls are equipped with complete hot-air heaters so that there are low solar costs. The paper contains information on the following subjects. 1. Aims and scales of the project: aims, location, plant. 2. Construction, installation and putting into operation: used technique, project management, problems, solutions, results, alternations, higher costs. 3. Operational results: operational history, performance, result of the project, operating expenses, future of the plant, profitability. 4. Publications, usufructs, etc.: publications, patent rights, future perspectives, commercial exploitation, gained experience, conclusions. 4 figs.

14427 (SAND–91-0582C) **General theme report: Working session 2, Solar thermal systems.** Alpert, D.J.; Kolb, G.J. Sandia National Labs., Albuquerque, NM (USA). [1991]. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9104123–2: 1991 solar power systems conference, Yalta (USSR), 22-26 Apr 1991). Order Number DE91009251. Source: OSTI; NTIS; GPO Dep.

Currently, over 90% of the world's large-scale solar electric energy is generated with concentrating solar thermal power plants. Such plants have the potential to meet many of the world's future energy needs. Research efforts are generally focused on generating electricity, though a variety of other applications are being pursued. Today, the technology for using solar thermal energy is well developed, cost competitive, and in many cases, ready for widespread application. The current state of each of the solar thermal technologies and their applications is reviewed, and recommendations for increasing their use are presented. The technologies reviewed in detail are: parabolic trough systems, central tower systems, and parabolic dish systems. 20 refs., 1 fig., 1 tab.

1409 Solar Thermal Utilization

Refer also to citation(s) 14420, 14433, 14703, 14819, 14867

14428 (DTH-LV-MEDD–216) **Solar heating system using a standard hot water container as a heat storage feasibility.** Fagerlund Carlsson, P. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Nov 1990. 80p. (In Danish). Contract ENS-151/89-34. Order Number DE91763423. Source: OSTI; NTIS (US Sales Only).

EFP-89.

Different designs of a solar heating system using a standard hot water tank as heat storage have been proposed. By means of water thermosyphoning in a loop between the tank and an external heat exchanger, heat is transferred from the solar collector loop to the tank. Different heat storage /heat transfer unit prototypes consisting of a standard horizontally situated hot water mantle tank and an external heat exchanger were installed and tested in a test facility for heat storages at the Thermal Insulation Laboratory. The principle worked as planned. A mathematical model, simulating the thermal performance of the prototype was validated by means of the tests. The suitability of solar heating systems using a standard tank and an external heat exchanger was estimated based on calculations of the thermal performance of the systems and on cost estimates. The investigations proved that the profitability of solar heating systems making use of a standard tank and an external heat exchanger is as good as the profitability of a normal solar heating system. Additionally, furhter improvemens of the new systems are possible. (author) 11 refs.

14429 (ENET–8900112/1) **Thermal comfort under variable conditions: Investigations into the expansion of conditions of comfort to band of comfort.** Frank, Th. (EMPA, Dbendorf (CH)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Apr 1990. 86p. (In German). Order Number DE91765821. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The present NEFF project enabled Swiss participation in the CEC research project EN3S-0035, 'thermal comfort in passive solar buildings' to be realized. The work involved was carried out in the laboratory for heating and air-conditioning engineered at the technical university of Lungby, Denmark. See also the closing report on the ASBRAE project 503, 'impact of air humidity on thermal comfort during step-changes'. In Switzerland additional investigations were carried out into thermal comfort in passive solar buildings, as part of the present project. For this purpose measurement results from four buildings already surveyed were used. The additional evaluations concerning thermal comfort principally take into account questions of the extent of the temperature and humidity fluctuations, acording to time and location, in passive solar buildings. The questions relating to thermal comfort during summer temperatures were the subject of the conluding work. For this purpose the latest tests from France and the USA, as well as ISO publications, were analyzed. figs., tabs., 27 refs.

14430 (ETDE-mf–1764490) **Solar trap for water heating.** Rauser, P. 1989 29p. (In German). Order Number DE91764490. Source: OSTI; NTIS (US Sales Only).

A number of experiments concerning the passive utilisation of solar energy was carried out between the 19.8.88 and the 15.2.1989. The equipment used corresponds to solar radiation traps. These are transparent freezer bags (sizes 17x18 cm^2 and 25x28 cm^2) made from plastic foil with a thickness of 100 μ and bags sized (26x31) cm^2 of even thinner foil. (orig.).

14431 (EUR–12752) **Demonstration of passive solar energy use with multiple fabric blinds in a school building and an office block: Demonstration project: Final report.** Quack, F. (Fraunhofer-Institut fuer Solare Energiesysteme (ISE), Freiburg im Breisgau (Germany, F.R.)); Bopp, G. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Fraunhofer-Institut fuer Solare Energiesysteme (ISE), Freiburg im Breisgau (Germany, F.R.). 1990. 120p. (In German, English). Sponsored by Commission of the European Communities, Brussels (Belgium). Contract SE/397/83 DE. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 11.25.

The aim is to reduce the cooling load in summer and the heating load in winter in each of the buildings by mounting multiple fabric roller blinds within or adjacent to the windows. These project details are included: Project aim and general description: project aim, description of the site, description of the installation; Construction, installation, commissioning: supplies of equipment and services, project management, problems, solutions, successes, modifications, cost increases, schedule; Operation and results: operating history, performance, success of the project, measurement program, operating costs, feature of the installation, economic viability; Publications, commercialization and other developments: publicity and publications, patent activity, outlook, commercialization, lessons learned, conclusions. 41 figs.

14432 (NEI-DK–495) **One day course in passive solar heat/insulation.** Gulstad, H. Bornholms Amtskommune. Roenne (Denmark). Energikontoret. 1990 45p. (In Danish). Contract TR-89.0561. Order Number DE91763364. Source: OSTI; NTIS (US Sales Only).

The aim of the course was to inform the participants of improved methods for the calculation of the amount of extra heat (from the sun) absorbed by glass extensions to apartment buildings (in the form of glass-covered balconies) or houses, and for the renovation of buildings in order to achieve a reduction in energy consumption. Types of glass materials were described in addition to methods for the insulation of existing buildings with mineral wool. (AB).

1410 Solar Collectors and Concentrators

14433 (DTH-LV-MEDD–215) **Development of roof solar collectors.** Kristiansen, F.; Svendsen, S. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Sep 1990. 37p. (In Danish). Contract TR-88.1205. Order Number DE91763424. Source: OSTI; NTIS (US Sales Only).

Two new solar roof cover systems for apartment buildings, one from BATEC and one from LfV, have been developed for collectors based on a corrugated acrylic sheet. The cover from BATEC has been fixed by thread sticks with nuts. The thread sticks clutch transversing iron pipes fixed to special fixtures mounted on the roof construction. 4 thread sticks have been used per square meter cover and the pipes are placed at intervals of about 0.5 m. The LfV-cover is glued to steel laths with an elastic silicone seal. The distance between the laths is 0.5 and 26 gluing points are used for each square meter of the cover. The steel laths are hooked onto special fixtures mounted on the roof construction. The cover plate is 1.3 m wide and up to 6m (12m) long. Some of the advantages of cover systems are the high solar transmittance (86%) and the low price of materials. For the LfV-cover system there is a minimum risk of leakage for rain penetration as there are no perforations in the plate. The system can be quickly mounted. The mechanical strength of the connection between the sheet and the thread stick of the cover system from BATEC resisted tensions up to about 1 kPa (100 kg/m^2). The silicone seal joint between the acrylic sheet and the steel lath of the LfV cover system resisted tensions up to about 3 kPa (300 Kg/m^2). Two 13 m^2 collectors with the new cover systems have been build on an outdoor test rig. The Efficiency is at the same level as for collectors with glass covers. Thermal expansion of the acrylic sheet gives no problems. (AB).

14434 (SAND–91-0570C) **The DOE Solar Thermal Electric Program Concentrator Technology Project.** Mancini, T.R. Sandia National Labs., Albuquerque, NM (USA). [1991]. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9103109–1-Vugraphs: SOLTECH '91 conference, Burlingame, CA (USA), 25-28 Mar 1991). Order Number DE91009253. Source: OSTI; NTIS; GPO Dep.

The project comprises the development of concentrating solar collectors, heliostats and dishes, and the development of optical materials. Because the solar concentrator represents from 40 to 60% of the cost of a solar thermal electric system, the continued development of high-performance concentrators is very important to the commercial viability of these systems. The project is currently testing two large area heliostats, the SPECO 200 m^2 heliostat and the ATS 150 m^2 heliostat and also trying to reduce the cost of the heliostats through the development of stretched-membrane heliostats. Stretched-membrane heliostats are made by attaching thin metal membranes to the two sides of a circular, metal ring. A slight vacuum in the plenum between the two membranes is used to focus the heliostat. The optical surface is provided by a silver-acrylic film, ECP 305. A prototype 100 m^2 commercial unit has been built and is currently being tested. Parabolic dish concentrators are under development for use on dish-Stirling electric systems. The state-of-the-art dish is the McDAC/SCE faceted glass concentrator. Because of the success of stretched-membrane technology for heliostats, the project applied the technology to parabolic dish development and is currently

designing a near-term, faceted, stretched-membrane dish. The current thrust of the program in optical materials development is the development of a low-cost, high-performance, silver-acrylic film. 3M's ECP 305 has demonstrated substantial improvement over previous films in its resistance to corrosion, longer life. An experimental film, developed at SERI, has promise for further improving the lifetime of the ECP 305. The project is currently investigating solutions to the problem of separation between the silver and acrylic layers of the film in the presence of water.

1420 Heat Storage

Refer also to citation(s) 14428

15 GEOTHERMAL ENERGY

1501 Resources and Availability

Refer also to citation(s) 14455

14435 (CONF-9004131–, pp. 5-7) **Geothermal energy development in the Pacific northwest.** Heys, M. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

Last summer, the author's company established an office in Portland, Oregon, under the banner of CE Exploration, to manage their activities in the Pacific Northwest. To date, they've spent about $15 million exploring and establishing a land position in the region. They now hold the rights to some 340,000 acres in Oregon and Washington - some of the most promising geothermal prospects in the country. Among them are: Mt. Mazama in the Winema National Forest; the Newberry Volcano in Oregon's Deschutes Nation Forest; the Bend Highlands, also in Oregon; Mt. Baker, in Washington; Mt. Adams, in Washington; Mt. Shasta, in the far north of California; and Glass Mountain, adjacent to UNOCAL's success there. The Bonneville Power Administration, once the envy of the nation for this surplus power, not long ago announced that it is short some 80 megawatts this year. CE Exploration believes power from geothermal resources is the answer, and that their Coso project can serve as a model for development of such new resources. The complex has been generating electricity commercially since June of 1987 and reached its currently planned capacity of 240 megawatts just before the beginning of the year. Nine power plants placed in service in less than 30 months: Quite a record. New that it is on-line, they are able to turn their attentions to other promising prospects.

14436 (CONF-9004131–, pp. 9-10) **The role of the California Energy Commission in geothermal research and development.** Smith, M. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

The California Energy Commission (Commission) plays several roles with respect to the development of geothermal energy in California. (1) The Commission reviews applications and, if appropriate, issues permits for thermal electric power plants with capacities greater than 50 MW. (2) The Commission prepares biennial forecasts of electricity supply and demand in California for 5-, 12-, and 20-year planning horizons. These forecasts, which appear in the Electricity Report, are essential to the Commission's determination of need (for capacity and energy) in its power plant siting process. These forecasts also will play a key role in future proceedings of the Public Utilities Commission (PUC) regarding new long-term standard offer contracts. (3) The Commission administers programs to promote the development of advanced fossil fuel and nonfossil fuel energy technologies, including geothermal energy. Since 1981, the Commission has supported the efforts of local governments relating to geothermal energy development. Through its Geothermal Grant and Loan Program, the Commission provides financial (grants and loans) and technical assistance to cities, counties, special districts, Indian governments, and municipal utilities for a wide variety of purposes. Each year, between $2-$3 million is made available for this program. These funds can be used (a) for local planning and policy development relating to geothermal energy; (b) to identify and mitigate the impacts of existing geothermal development; and (c) for resource exploration and development. While recognizing the importance of near-term research and development, the Commission also is concerned about the future of the geothermal industry. To this end, the Commission is working with DOE on several long-term research and development programs.

14437 (CONF-9004131–, pp. 113-121) **HDR technology transfer activities in the Clear Lake area, California.** Burns, K. (Los Alamos National Lab., NM (USA)); Potter, R. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

A large Hot Dry Rock resource has been recognized in northern California, underling the region extending NE of The Geysers to N of the City of Clearlake. The geothermal resource is heterogeneous. There are two mechanisms of heat flow occurring together. One is fluid transport, up natural zones of permeability, to outflows as surface springs. The other is conductive heat flow through impermeable rock. The temperature isotherms are thought to be nearly level surfaces, for example, the 300°C isotherm is at about 8000 ft depth, with spikes or ridges occurring around narrow zones of fluid flow. While there is accessible heat at shallow depth in the naturally permeable rocks, the really substantial resource is in the impermeable rock. This is the HDR resource. The potential reservoir rocks are Franciscan greywackes and greenstones. Recorded drilling problems appear to be mainly due to intersection with serpentinites or to the effects of stimulation, so are potentially avoidable. Greywacke is favoured as a reservoir rock, and is expected to fail by brittle fracture. The water shortages in Northern California appear to be Surmountable. Sewerage water may be available for fill and makeup. There is a possibility of combining HDR heat power production with sewerage disposal. To establish the first HDR producer in Northern California offers challenges in technology transfer. Two significant challenges will be creation of dispersed permeability in a greywacke reservoir, and pressure management in the vicinity of naturally permeable zones.

14438 (CONF-9004131–, pp. 129-137) **The geopressured-geothermal resource, research, and use.** Negus-de Wys, J. (Idaho National Engineering Lab., Idaho Falls (USA)). USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

The Geopressured-Geothermal Resource has an estimated accessible resource base of 5,700 quads of gas and 11,000 quads of thermal energy in the onshore Texas and Louisiana Gulf Coast area alone. The program presently has three geopressured-geothermal wells in Texas and Louisiana. The Pleasant Bayou Well has a 1 MWe hybrid power system converting some gas and the thermal energy to electricity. The Gladys McCall Well produced over 27 MM bbls brine with 23 scf per bbl over 4 112 years. It is now shut-in building up pressure. The deep Hulin Well has been cleaned out and short-term flow tested. Supporting research includes research on rock mechanics, logging, geologic studies, reservoir modeling, co-location of brine and heavy oil in Texas and California, on environmental monitoring and geologic studies, hydrocarbons associated with the geopressured brines, and development of a pH

monitor for harsh environments. Recently, Lawrence Berkeley Laboratory has been added to the research support in prediction of reservoir behavior. EG&G Idaho, Inc. is developing feasibility studies in FY-1990 on four use areas: (1) Thermal Enhanced Oil Recovery, (2) Direct Use, (3) Hydraulic and Thermal Conversion, and (4) Use of Supercritical Processes and Pyrolysis in Detoxification. This on-going research and well operations are preparing the way to commercialization of the Geopressured Geothermal Resource. In January 1990 an Industrial Consortium for the Utilization of the Geopressured-Geothermal Resource was convened at Rice University, Houston, TX. Sixty-five participants heard industry cost-shared proposals for using the hot geopressured brine. Proposals ranged from thermal enhanced oil recovery to aquaculture, energy conversion, and environmental clean up processes.

14439 (CONF-9004131–, pp. 139-143) **Assessment of geopressured-geothermal resources for near-term utilization.** Groat, C.G.; John, C.J.; Stevenson, D.A. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

Geologic studies and the test well programs supported by the Department of Energy have provided a better defined geologic framework for determining the true production potential of the thermal, kinetic, and dissolved methane components of the resource. New geophysical data are making it possible to complete the geologic analysis of the reservoirs at two of the designed test well sites which will aid in refining reservoir performance models. Production of geopressured brines at the Gladys McCall test well in coastal southwestern Louisiana had reached 27 million barrels when flow testing was discontinued in October, 1987. Reservoir modeling has been somewhat hampered by a lack of detailed geologic data on reservoir extent, geometry, and textural variations. Only limited production has occurred at the Hulin site near Erath, Louisiana where the deepest, hottest, and potentially largest geopressured reservoir system has been penetrated. The geologic understanding of this reservoir is also limited by the lack of other wells reaching to or beyond the depth of the reservoir of interest. Proprietary modern geophysical data from both areas are being used to more accurately portray the extent of the tested reservoirs and their relationship to other sand bodies. Given the increased emphasis being placed on natural gas in the development of energy strategies for the future, the estimated 5700 Tcf of speculative geopressured dissolved gas resources should be reassessed and data bases consolidated. This is necessary to bring our understanding of the geopressured gas resource onto a par with tight gas and unconventional gas resources that have received more attention in recent years. Environmental monitoring at test well sites continues to demonstrate a lack of contemporaneous adverse subsidence, fault activation, and water quality impacts related to brine production and disposal.

1502 Geology and Hydrology of Geothermal Systems

Refer also to citation(s) 14437, 14438, 15301

14440 (CONF-9004131–, pp. 173-175) **Silicic magma in the crust.** Eichelberger, J.C. (Sandia National Labs., Albuquerque, NM (USA)). USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

In its assessment of geothermal resources of the United States, the US Geological Survey addressed the magma resource base. Their estimate is that 50,000 to 500,000 Quads of thermal energy are contained in molten or partially molten magma residing in the crust at depths less than 10 km. This estimate of the potential magma resource is larger than the US fossil resource and roughly 650 to 6500 times the total annual US energy consumption. Thus, magma is an alternative energy resource with enormous potential. Engineering technology can be developed to recover this energy for depths less than 10 km. The critical need at this stage of development is a verification of the existence, character, and size of he magma resource. It is known from the geologic record that magma reservoir that develop at accessible depth are commonly of silicic rather than basaltic composition. This paper summarizes what is known and could be learned about silicic magma bodies.

1503 Geothermal Exploration and Exploration Technology

Refer also to citation(s) 14443, 14449, 14452

14441 (CONF-9004131–, pp. 69-74) **Management of geothermal resources.** Nielson, D.L.; Wright, P.M.; Adams, M.C.; Moore, J.N.; Tripp, A.C. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

The past year's research has placed a greater emphasis on problems identified at The Geysers. As more geothermal systems reach a mature stage of production, production declines will become more common unless effective resource management techniques are developed. Work is progressing on the development of vapor-phase tracers, and we are planning a tracer test with several of the operators. Mineralogical and geochemical studies to determine the origin and distribution of corrosive steam are continuing in cooperation with GEO Operator and UNOCAL. Hydrogeochemical studies using fluid-inclusion and chemical data are continuing at Coso, Steamboat, Heber and the Valles caldera. This work is documenting fluid flow in fractured geothermal systems and in changes in fluid chemistry caused by production. The investigation of the application of borehole geophysics has continued with the development of two different 2-dimensional inversion algorithms for interpretation of cross borehole and borehole-to-surface data. Instrumentation is being assembled to field test the method. The authors believe that these techniques can be effective in mapping permeable zones and reservoir boundaries. In addition, this method can potentially be used to monitor drying out of vapor-dominated reservoirs and cold-water influx into liquid-dominated reservoirs. Investigations of the state of stress in the Heber geothermal field suggest that borehole breakouts may be related to the proximity of major fracture zones. Concepts of stress have been used to develop a model for The Geysers system in which a structural arch effectively decouples the reservoir from the vertical stress. This model will be important in planning injection to control pressure declines.

14442 (CONF-9004131–, pp. 87-89) **Borehole directional radar.** Hommert, P.J. (Sandia National Labs., Albuquerque, NM (USA)). USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

A directional radar tool is being developed for application in high resolution imaging of structure near a borehole. Previously, a prototype tool was constructed and tested in both laboratory and field environments. Targets in fractured media were successfully detected, however, the overall system dynamic range was found to be only about 40 dB. During FY89, work on the borehole radar focused on both mechanical and electrical redesign of the initial prototype. Also, in an effort to better define the operating characteristics that will be required of the eventual field system, a numerical model was developed that predicts the magnitude of reflected radar signals as a function of the host rock electrical properties and the fracture characteristics. Model studies indicate

that a significant improvement in system dynamic range (40 to 60 dB) will be necessary for the borehole radar to be of practical use in locating fractures in most geothermal reservoirs. The electrical and mechanical modifications initiated in FY89 should achieve much of the needed improvement in dynamic range with changes in the antenna design achieving the remainder and possibly more.

1506 Environmental Aspects

Refer also to citation(s) 14439, 14454

1508 Geothermal Power Plants

Refer also to citation(s) 14435, 14455

14443 (CONF-9004131–, pp. 19-26) **Hydrothermal energy - an important part of America's energy strategy.** Taylor, K.J. (Idaho National Engineering Lab., Idaho Falls (USA)); Reed, M.; Ross, H. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

The US Dept. of Energy (DOE) established a Geothermal Energy Program in the mid-1970's as one response to America's need to develop alternative energy sources. One element within the Geothermal Program is Hydrothermal Energy. which includes Industrialization, Reservoir Technology, and Conversion Technology as separate tasks. The successes which have resulted from this program, combined with anticipated future progress, will increase the role of geothermal energy as a contributor to our nation's future energy needs. Geothermal energy has become an important component of the U.S. National Energy Strategy. With continued research in the Hydrothermal program, ultimate objective of reducing the cost of electricity produced from the hydrothermal resource will be achieved. As this takes place, it will be a positive step in our country's search for alternate energy sources. More importantly, it will allow our nation to reduce its' need for foreign energy products.

14444 (CONF-9004131–, pp. 27-34) **Advanced binary geothermal power plants limits of performance.** Bliem, C.J. (Idaho National Engineering Lab., Idaho Falls (USA)); Mines, G.L. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

The Heat Cycle Research Program is currently investigating the potential improvements to power cycles utilizing moderate temperature geothermal resources to produce electrical power. Investigations have specifically examined Rankine cycle binary power systems. Binary Rankine cycles are more efficient than the flash steam cycles at moderate resource temperatures, achieving a higher net brine effectiveness. At resource conditions similar to those at the Heber binary plant, it has been shown that mixtures of saturated hydrocarbons (alkanes) or halogenated hydrocarbons operating with a supercritical Rankine cycle gave improved performance over Rankine cycles with the pure working fluids executing single boiling cycles. Recently, in addition to the supercritical Rankine Cycle, other types of cycles have been proposed for binary geothermal service. This paper explores the limits on efficiency of a feasible plant and discusses the methods used in these advanced concept plants to achieve the maximum possible efficiency. The advanced plants considered appear to be approaching the feasible limit of performance so that the designer must weigh all considerations to find the best plant for a given service.

14445 (CONF-9004131–, pp. 153-157) **Operation of a geopressured hybrid power system at Pleasant Bayou.** Campbell, R.G. (Ben Holt Co., Pasadena, CA (USA)); Hatter, M.M. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

The U.S. Department of Energy and Electric Power Research Institute are co-funding a demonstration of the hybrid cycle power concept on a geopressured resource. The power plant was constructed at the Pleasant Bayou geopressured test facility in Texas and has been operational since August 1989. This paper presents a review of the design and construction and a detailed discussion of plant operation and performance. The system is designed to operate on 10,000 BBL/day of geopressured brine containing 22 SCF of gas/BBL. This flow is approximately one half of the total flow from the Pleasant Bayou well. The gas is approximately 87 percent methane with the balance mostly carbon dioxide. Power can be produced from three forms of energy in the cycle. The first form is hydraulic energy, which an be recovered in the pressure reduction turbine. The second form of energy is chemical energy, recovered by burning the methane in a gas engine. The final form of energy recovered is heat. The high temperature engine exhaust gas and the hot geothermal brine provide heat to a binary cycle.

1509 Geothermal Engineering

Refer also to citation(s) 14437, 14438, 14439, 14443

14446 (CONF-9004131–, pp. 35-39) **Advanced materials for geothermal applications.** Kukacka, L.E. (Brookhaven National Lab., Upton, NY (USA)). USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

Before geothermal energy can make a significant contribution to the nation's energy supply, improvements in its economic and technological viability must be made. The continued development and utilization of advanced materials of construction will help to attain these goals. To address these needs, emphasis is being placed on materials which will substantially reduce the cost of drilling and completion, and for energy conversion. Successful developments will also result in improved safety and lessen the environmental impacts of geothermal development. High priority needs are for advanced high temperature lost circulation control materials, carbon dioxide resistant lightweight cement well completion materials, and tools such as drillpipe protectors, rotating head seals, blow-out preventors, and downhole drill motors. The lack of suitable hydrolytically stable chemical systems that can bond previously developed elastomers to metal reinforcement is a critical but as yet unaddressed impediment to the development of these tools. The availability of low cost, thermally conductive, corrosion and scale-resistant tubular lining materials for use in shell-and-tube heat exchangers and other components, would greatly enhance transport and energy extraction processes utilizing hypersaline brines, and possibly increase the exploitable low temperature geothermal energy reserves for commercial development. Work to address all of these materials needs is underway at Brookhaven National Laboratory. Recent developments, and plans for the coming year are summarized in the paper.

14447 (CONF-9004131–, pp. 57-61) **Reservoir technology research at LB addressing Geysers issues.** Lippmann, M.J. (Lawrence Berkeley Lab., CA (USA)); Bodvarsson, G.S. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. DOE Contract AC03-76SF00098. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

The Geothermal Technology Division of the Department of Energy is redirecting a significant part of its Reservoir Technology funding to study problems now being experienced at The Geysers. These include excessive pressure drawdown and associated decline in well flow rates, corrosion due to high chloride concentration in the produced steam and high concentration of noncondensible gases in some parts of the field. Lawrence Berkeley Laboratory (LBL) is addressing some of these problems through field, laboratory and theoretical studies. The paper describes The Geysers database, injection modeling, microseismic monitoring of the NW Geysers, development of a downhole fluid sampler, and multiphase flow in fractured rock.

14448 (CONF-9004131–, pp. 63-67) **Adsorption in vapor-dominated systems.** Ramey, H.J. Jr. (Stanford Univ., CA (USA)). USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

Vapor-dominated geothermal systems have been produced for almost 90 years. But the storage mechanism is still in doubt. The fluid must be stored as a liquid, yet the pressure at reservoir temperature is well into the superheated steam region for flat-surface thermodynamics. One popular mechanism is that the liquid phase is a brine. Another possibility is that the liquid phase is adsorbed. A study of the Big Geysers shallow steam production indicates that adsorption is a reasonable mechanism.

14449 (CONF-9004131–, pp. 75-80) **Reservoir related research at Idaho national Engineering Laboratory, Lawrence Livermore National Laboratory, and Oak Ridge National Laboratory.** Renner, J.L.; Kasameyer, P.W.; Mesmer, R.E. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

INEL's research has centered on the development of a reservoir simulation code to predict heat and solute transfer in fractured, porous media. In support of the initiatives for research at The Geysers, INEL will initiate in cooperation with Lawrence Berkeley Laboratory, studies of injection and related interference effects at The Geysers. Work at LLNL is centered on analysis of the seismicity associated with production and injection at geothermal systems and effects of geothermal systems on seismic signals. LLNL is continuing studies of seismic attenuation related to the presence of steam at The Geysers. ORNL conducts research to obtain the thermodynamic and kinetic data needed as input into geochemical models such as those being developed by John Weare of the University of California, San Diego that predict the phase behavior and corrosion characteristics of geothermal brines. The current program at ORNL addresses the ion interaction parameters of bisulfate ion (HSO^-) with H^+ and Na^+, the dissociation constant of HSO_4^-,OH^-, and the solubility and specification of aluminum in the system H^+-Na^+-K^+-Cl^--OH^-. ORNL is initiating studies of the distribution of HCl in steam in support of the expanded research program at The Geysers. INEL is also involved in several other activities in Support of the development of geothermal resources. INEL acts as liaison between the Geothermal Technology Organization and DOE and provides contract support for initiation of joint research. INEL also participated with several other National Laboratories in preparation of an analytical study of renewable resources in support of DOE's ongoing National Energy Strategy. As a result of this study, INEL is initiating a review of geothermal reserves.

14450 (CONF-9004131–, pp. 83-86) **Overview: Hard rock penetration.** Dunn, J.C. (Sandia National Labs., Albuquerque, NM (USA)). USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

The Hard Rock Penetration program is developing technology to reduce the costs of drilling and completing geothermal wells. Current projects include: lost circulation control, rock penetration mechanics, instrumentation, and industry/DOE cost shared projects of the Geothermal Drilling Organization. Last year, a number of accomplishments were achieved in each of these areas. Laboratory test equipment was designed and built to evaluate cementitious muds and polyurethane foams for lost circulation control in major fracture zones. Models for particulate plugging of loss zones were developed and used to summarize extensive laboratory data collected for a wide variety of material additives. Scale-model transmitting and receiving transducers were fabricated and tested for acoustical data transmission through drill pipe. Active noise, and echo suppression was demonstrated and the drill pipe transmission concept was verified. Final testing of our prototype borehole directional radar was completed and an extensive redesign was initiated. The surface data acquisition system was completed for the GDO high-temperature borehole acoustic televiewer and logs were successfully obtained in the Salton Sea at temperatures up to 293°C. New drill pipe protectors that use a higher temperature elastomer were manufactured for geothermal applications and tested in the Geysers.

14451 (CONF-9004131–, pp. 91-97) **Lost circulation technology development projects.** Glowka, D.A. (Sandia National Labs., Albuquerque, NM (USA)). USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

Lost circulation is the phenomenon where circulating drilling fluid is lost to fractures or pores in the rock formation rather than returning to the surface through the wellbore annulus. In geothermal drilling, lost circulation can be a serious problem that contributes greatly to the cost of the average geothermal well. A DOE-sponsored program is underway at Sandia National Laboratories to develop new technology for solving lost circulation problems. The Lost Circulation Technology Development Program currently consists of twelve projects in three areas: technology to plug porous and minor-fracture loss zones; technology to plug major-fracture loss zones; and technology to characterize loss zones. This paper describes the program and highlights recent progress.

14452 (CONF-9004131–, pp. 101-108) **Status of the hot dry rock geothermal energy development program at Los Alamos.** Duchane, D. (Los Alamos National Lab., NM (USA)). USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. DOE Contract W-7405-ENG-36. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

The Hot Dry Rock (HDR) Geothermal Energy Development Program is an effort to utilize the inherent heat present in dry rock at depth as a source of energy. The HDR resource base is extremely large and is widespread. It has been estimated that HDR energy reserves are on the order of 10 billion quads in the United States alone. As a point of comparison, world energy consumption in all forms is about 300 quads per year. Thus HDR potentially could supply the energy requirements of the U.S., and indeed, the world, for many thousands of years, even if only a small fraction of the total HDR resource could be economically accessed. A brief historical synopsis, the most recent work done at Los Alamos, future plans, and advanced concepts in HDR technology are discussed in this paper. During the past two decades, the extraction of energy from HDR has been scientifically demonstrated and a large HDR

reservoir has been created at Fenton Hill, New Mexico. Developments in drilling and logging hardware, reservoir engineering, seismic science, tracer analysis, and modeling have all contributed to the advance of HDR technology. The long term flow test planned for the early 1990's will provide a basis for future commercial exploitation of HDR resources worldwide. Given an adequate commitment of developmental resources, HDR may begin to supply environmentally sound and economically attractive energy to the world within a period of five to ten years.

14453 (CONF-9004131–, pp. 109-112) **Using HDR technology to recharge The Geysers.** Brown, D.W. (Los Alamos National Lab., NM (USA)); Robinson, B.A. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

The main reason for the productivity decline at The Geysers geothermal field is obvious: more fluid is being withdrawn from the reservoir than is being returned by reinjection and natural recharge. However, there is another factor that may be contributing to this decline – the method of reinjection. By reinjecting cold condensate directly into the steam dome as is the current practice, the very large pressure difference between the injected condensate and the underpressured reservoir guarantees that the reinjected fluid will fall rapidly to the bottom of the reservoir, with very little residence time for heat transfer. A more thermally effective method of reinjection is here proposed, using stimulation techniques developed in the Hot Dry Rock (HDR) Program. The injection of fluid, either into boundary regions just outside the productive reservoir or below the boiling interface, would be obvious approaches. These regions are under much higher earth stresses than the main body of the reservoir, providing a large inward flow potential. However, no matter how thermally effective this method of artificial recharge might be, the amelioration of the productivity decline at The Geysers still will be directly related to the amount of fluid available for reinjection relative to the overall mass rate of steam production. Assuming that a fracture zone similar to the Fenton Hill reservoir could be created adjacent to the steam field, preliminary modeling results, indicate that over two-thirds of tile injected fluid will be flowing into the reservoir after only 20 days of pumping. This fluid will start to flash as it approaches the underpressured reservoir through the network of stimulated joints, providing a hot recharge with a significant steam fraction. To evaluate this concept, a series of tests should be conducted in several nonproductive regions of The Geysers, in cooperation with one or more of the major steam producers.

14454 (CONF-9004131–, pp. 125-128) **Geopressured energy - an environmentally safe alternative.** Taylor, K.J. (Idaho National Engineering Lab., Idaho Falls (USA)). USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

As a response to the America's need for alternate energy sources, the United States Department of Energy has a Geothermal Program. Within this program is a category to study Geopressured Energy. Today many activities are taking place under the Geopressured Program. These activities for the most part fall under one of the following categories: Well Operations, Geoscience & Engineering Support, Energy Conversion and Technical Transfer. To date this program has had many successes. However, there is still more information needed concerning the Geopressured Resource. It is thought that continued research Will give the developer a better understanding of the Geopressured resource and in turn increase the likelihood of it's development.

14455 (CONF-9004131–, pp. 145-152) **Geopressured-geothermal energy field operations.** Eaton, B.A. (Eaton Operating Co., Inc., Houston, TX (USA)); Meahl, T.E.; Featherston, C.R. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

America's increasing dependence on foreign energy sources and the national environmental initiatives based on the increasing awareness of the need for protection of environment have led to the Department of Energy's (DOE) development of domestic U.S. alternative energy programs. One of these programs is the current geopressured-geothermal five year program conducted at three sites in Louisiana and Texas. Excellent results have been obtained in reaching the objectives for this well operation and energy conversion project, which are: To determine geopressured-geothermal reservoir sizes and drive mechanism by long-term, high volume flow testing. Prove long-term injectability of large volumes of spent brine. Develop technology for automated operation of geopressured-geothermal production systems. Develop modified scale inhibitor treatment procedures. Develop technology to produce power economically from the geopressured-geothermal resource.

14456 (CONF-9004131–, pp. 161-172) **Overview: Magma energy.** Dunn, J.C. (Sandia National Labs., Albuquerque, NM (USA)). USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

Crustal magma bodies located in the crust at shallow depth represent an enormous potential resource that deserves to be evaluated for development within the next 10 to 15 years. The estimate of the potential magma resource base in the U.S. is as high as 500,000 quads. Several years of DOE supported R & D in magma energy extraction have changed the prevailing attitude about this concept from: Of course there is a major magma resource, but it cannot be harnessed to: if there is a major body of magma at shallow depths, energy can be extracted. The important questions have been addressed and satisfactorily answered in a preliminary sense. This includes designing insulated drill pipe to extend drilling techniques used successfully in molten lava at Kilauea Iki lava lake to depths typical of crustal magma bodies. Materials research has identified and tested several common superalloys that will survive the expected energy extraction environment for several years. Extensive experimental and numerical analyses of energy extraction processes have resulted in projections of single well energy extraction rates of 25 to 45 MW(e). The primary unanswered question at this stage of development is: What is the nature of the crustal magma resource? (How deep? What volume? What thermal state?) These questions can only be answered by deep drilling into the magmatic regime. The Long Valley caldera deep exploratory well is designed as a beginning to address these important issues. Long Valley is a very large silicic caldera that best typifies the magma resource estimate. The well, located on the resurgent dome, will provide a stringent test of the hypothesis that magma is still present within the central plutonic complex of this active caldera.

14457 (CONF-9004131–, pp. 177-178) **Phase I drilling operations for the magma energy exploratory well.** Finger, J.T. (Sandia National Labs., Albuquerque, NM (USA)). USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

This paper describes the drilling operations for Phase I of the Magma Energy Exploratory Well in Long Valley caldera, near Mammoth Lakes, California. The hole is to be drilled in four yearly

phases, with time for scientific experiments between the drilling intervals. Phase I was conducted during August - September 1989, and resulted in a 20 cased hole to 2550 feet. Although the drilling encountered fractured zones with massive lost circulation, the hole is in excellent condition and is at the depth and diameter specified in the original design.

14458 (SAND–88-7115) **Evaluation of saponite and saponite/sepiolite fluids for geothermal drilling.** Guven, N. (Texas Tech Univ., Lubbock, TX (USA). Dept. of Geosciences); Panfil, D.J.; Carney, L.L. Sandia National Labs., Albuquerque, NM (USA); Texas Tech Univ., Lubbock, TX (USA). Dept. of Geosciences. Feb 1991. 109p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009854. Source: OSTI; NTIS; GPO Dep.

The rheology and other properties of drilling fluids containing saponite and a saponite-sepiolite mixture as the main vicosifier have been systematically evaluated in the temperature range of 300-600°F under appropriate confining pressures up to 16,000 psi. Saponite represents the magnesium analog of the clay mineral montmorillonite, which is the main constituent in conventional bentonite-based fluids. The fluid with 6% saponite exhibits a prominent viscosity enhancement at temperatures above 250°F. This viscosity enhancement is easily controlled by salts and hydroxides of Na and K. The addition of Na-polyacrylates (low- and high-molecular weight polymers) eliminates the viscosity anomaly of pure saponite fluids. These polymers also increase the filtration control of saponite. The anomalous viscosity enhancement of saponite is significantly reduced by the addition of sepiolite (a clay mineral with a fibrous morphology). Sepiolite readily converts into thin films of smectite at 300°F and above which improves the filtration control of these fluids at high temperatures. This mixture demonstrates considerable potential for drilling geothermal wells. New fluids have been formulated by adding various polymers (Na-polyacrylates) to the saponite/sepiolite mixture. These formulations display excellent rheology and filtration control at elevated temperatures which will enhance performance in geothermal drilling. The properties of these fluids can be adjusted by controlling the relative concentrations of these constituents. 12 refs., 31 figs., 26 tabs.

14459 (SAND–90-1344) **Phase 1 drilling operations at the Magma Energy Exploratory Well (LVF 51-20).** Finger, J.T.; Jacobson, R.D. Sandia National Labs., Albuquerque, NM (USA). Dec 1990. 99p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009098. Source: OSTI; NTIS; GPO Dep.

This report describes the Phase 1 drilling operations for the Magma Energy Exploratory Well near Mammoth Lakes, California. An important part of the Department of Energy's Magma Energy Program, this well is designed to reach an ultimate depth of 20,000 feet or a bottomhole temperature of 500°C, whichever comes first. There will be four drilling phases, at least a year apart, with scientific investigations in the borehole between the drilling intervals. Phase 1 of this project resulted in a 20 inch cased hole to 2558 feet, with 185 feet of coring beyond that. This document comprises a narrative of the daily activities, copies of the daily mud and lithologic reports, time breakdowns of rig activities, inventories of lost circulation materials, temperature logs of the cored hole, and a strip chart mud log. 2 figs.

1510 Direct Energy Utilization

14460 (DOE/ID/12693–1) **Direct use R&D assistance: Final Report, January 1988–September 1990.** Lienau, P.J.; Culver, G.; Rafferty, K. Oregon Inst. of Tech., Klamath Falls, OR (USA). Geo-Heat Center. [1990]. 71p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG07-87ID12693. Order Number DE91009976. Source: OSTI; NTIS; GPO Dep.

Progress in technology transfer and R and D of geothermal direct uses in three areas, by the Geo-Heat Center, are reviewed in this report. First, technical assistance was provided to 81 projects covering the entire development process from resource information to troubleshooting problems after a project has been completed. Second, applied research was conducted on: the performance of materials and equipment used in 13 geothermal district heating systems, wellbore/aquifer interaction and worldwide utilization of downhole heat exchangers, development of a US direct-use site data base, and development of information on transmission/distribution piping and analysis of uninsulated pipe for geothermal district heating systems. Third, an overview is presented on a technology transfer program which included: publishing a Guidebook, topical papers, and quarterly Bulletin, advising and referrals on projects, presentation and tours, geothermal library, and reporting activities to the Geothermal Progress Monitor. Papers on applied research projects have been processed separately for inclusion on the data base.

14461 (EUR–12345) **Geothermal energy - Southampton. Demonstration project.** Commission of the European Communities, Luxembourg (Luxembourg). 1989. 26p. Contract no. GE 607/83-UK. Source: OSTI; NTIS (US Sales Only).

The aim of the project is the use of the geothermal source to provide heating for office buildings, schools, shopping centers, commercial premises and dwellings located near the City Center of SOUTHAMPTON. The Southampton Geothermal Heating Company was created to promote a district heating. Heat is produced from the Heat Station where a 2 MW geothermal heat exchanger is installed close to a 250 kVA diesel engine with heat recovery and a 2 MW dual fuel boiler. The Heat Station is controlled by a fully automatic system which manages the energies and records the operation parameters. The system is designed to use the geothermal resource as a priority. The internal heating system in each consumer's building was not changed; heat exchangers were only installed inside the consumer's boiler houses and connected to the district heating mains; existing boilers are kept for peak demands and stand-by. All the buildings located in the City Center represent such a potential heat consumption that the level of 1 500 t.e.p./year of substituted energy can be envisaged in the further stages. The operation of the scheme successfully began in March 88; since that date, the geothermal source has contributed to the heating of the Southampton City Council and the Hampshire County Council.

1520 Geothermal Data and Theory

Refer also to citation(s) 14449, 15515

14462 (CONF-9004131–, pp. 49-53) **Chemical models for optimizing geothermal power production.** Weare, J. (Univ. of California, San Diego (USA)); Moeller, N.; Duan, Z.; Greenberg, J. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings*. 185p. Order Number DE91004623. Source: OSTI; NTIS.

The purpose of the UCSD Brine Modeling Program is to develop technology which will improve the efficiency of geothermal operations. The authors are constructing computer models which can evaluate the energy content and the likelihood of scale formation of geothermal brines with their associated gas phases under a wide variety of operating conditions (species, temperature, pressure). The present model, with a temperature range of 0°-250°C, can predict calcium carbonate, calcium sulfate, and amorphous silica scale formation as a function of brine composition and partial pressure of CO_2. It can also predict the presence of other less common scales, such as sodium chloride. New developments include improvement of the representation of mixed gas phase behavior in high pressure formations. The authors have modeled the thermodynamic behavior of gaseous mixtures in the $CO_2(g)$-$CH_4(g)$-$H_2O(g)$ system from 0° - 1000°C and from 0 - 3500 atm. These ranges in P and T allow application to geopressured systems. Progress has also been made in modeling the behavior of the H_2S (g)-H_2O (g) system. Using a reliable representation of the gas phase (Redlich - Kwong), a model which predicts the solubility and gas phase thermodynamics for this system for temperatures from 0° - 90°C and for pressures from 0 - 60 atm has been developed. The T and P ranges are limited by the lack of high temperature data. This preliminary model may be used in engineering studies of the abatement of H_2S and will eventually be part of a model of sulfide

scale deposition. The authors are continuing efforts to incorporate more species that are important for geothermal applications.

1540 Waste Management

Refer also to citation(s) 14455

14463 (CONF-9004131–, pp. 41-47) **Developments in geothermal waste treatment biotechnology.** Premuzic, E.T. (Brookhaven National Lab., Upton, NY (USA)); Lin, M.S.; Kang, S.K. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

Technical feasibility of a technology based on biochemical processes for the conversion of geothermal wastes from hazardous to non-hazardous wastes has been demonstrated. Laboratory-scale, studies have shown that biotechnology for detoxification of geothermal wastes is versatile and is applicable to a variety of geothermal sludges containing few or many metals whose concentrations may exceed limiting threshold concentrations as recommended by regulatory agencies. Metals, such as chromium, copper, manganese and others, can be removed with 80-90% efficiencies. Continuing studies aimed at optimization and scaling-up of processes used in the emerging biotechnology indicate that there are several essential process variables which have to be considered in the development of geothermal waste treatment biotechnology. Some recent studies dealing with process variables will be discussed.

16 TIDAL AND WAVE POWER

1605 Environmental Aspects

14464 (ETSU-TID–4080) **A review of methods of extrapolating tidal model predictions to long term siltation effects in estuaries.** AEA Environment and Energy, Harwell (UK). Energy Technology Div.; Hydraulics Research Ltd., Wallingford (UK). 1990. 80p. Order Number DE91763840. Source: OSTI; NTIS (US Sales Only).

Sites which have prospects for tidal power generation almost invariably have large expanses of potentially mobile sand banks, mud shoals and intertidal sand or mud flats. The construction and operation of a tidal power plant alters the tidal regime and hence the pattern of sediment transport within the sphere of influence of the engineering works. At present, there is no generally accepted method of predicting the long term effects of a major tidal power barrage on the equilibrium distribution of sediment in a large wide estuary. Detailed multi-dimension mathematical models are criticised because they appear only to predict the immediate impact of the proposed engineering works on the sediment regime. The largely empirical regime technique is commonly used to predict changes in the cross-sectional area of the estuary. However, there is a less widely used, but much more powerful, technique whereby the results from short term predictions are extrapolated in an interactive process to predict long term siltation. There are no established, tested theories or standard methods for extrapolating results from short term siltation models. For this reason this review is based on an analysis of a number of case studies, which represent the only readily available source of experience with the problem. The case studies do not relate to tidal barrage projects, but they do illustrate and demonstrate the basic principles and problems associated with the extrapolation of short term predictions. (author).

17 WIND ENERGY

Refer also to citation(s) 14677

1703 Legislation and Regulations

14465 (ECN–90-013) **Regulations for the type certification of wind turbines: Technical criteria: Draft standard NEN 6096, 2. ed., version 1.0.** Stam, W.J. (ed.). Netherlands Energy Research Foundation, Petten (Netherlands). Nov 1990. 79p. (In Dutch). Order Number DE91760540. Source: OSTI; NTIS (US Sales Only).

Technical tests which are used to certify certain types of wind turbines are presented. The certification criteria are aimed at a safe operation of the wind turbines and at efficient generation of power. The criteria are valid for manufactured mass-produced power generating grid connected wind turbines with horizontal axis and a rotor diameter larger than 5 m. The criteria concern: quality of the documentation; safety systems; electric, electronic, hydraulic and pneumatic systems; occupational safety; quality control; regulations with regard to maintenance, operation, inspection and safety; energy production; noise production, and reliability. 3 figs., 23 refs., 5 tabs., 2 apps.

1704 Economic, Industrial, and Business Aspects

Refer also to citation(s) 14467, 14468, 14469

1706 Wind Energy Engineering

Refer also to citation(s) 14405, 14465, 15200

14466 (ETDE-mf–1764473) **BERWIAN - development, construction and operation of a novel wind power plant with a vortex screw concentrator (Phase II). Final report.** Rechenberg, I. Technische Univ. Berlin (Germany, F.R.). Fachgebiet Bionik und Evolutionstechnik; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1990 333p. (In German). Contract BMFT 032 8412B. Order Number DE91764473. Source: OSTI; NTIS (US Sales Only).

This final report comprises three sections: Part 1: The BERWIAN project - from the first prototype to the SUeDWIND plant at Kaiser-Wilhelm-Koog. Part 2: Theoretical and experimental studies on power control. Part 3: Theoretical and experimental studies on rigid and flexible variable-incidence wings for the BERWIAN concentrator wind turbine. (orig./KW).

14467 (EUR–12117) **Wind energy for easterhoull chalets. Demonstration project.** Gurudeo S. Saluja, (Robert Gordon's Institute of Technology, Aberdeen (UK)). Commission of the European Communities, Luxembourg (Luxembourg). 1989. 79p. Contract No WE/96/83-UK. Source: OSTI; NTIS (US Sales Only).

This report summarises operating experience and analyses the economics of a small grid connected wind turbine generator. The analysis is based on 33-month performance data from the CEC supported demonstration project at Scalloway in the Shetland Islands of Scotland to provide wind generated electricity to tourist isolated and island communities. A Vestas 55/11 kW, 15 m rotor diameter wind turbine generator was installed in August 1985 and has been operating satisfactorily since then. A user oriented approach has been adopted to calculate the actual cost savings as a direct result of installing the wind turbine. The implications of the special terms for supply of electricity to small private generators by the North of Scotland Hydro Electric Board - the electricity authority in the area - are considered. A comparison is made with various tariff structures operated within the Board's diesel and non-diesel areas for domestic, farm and general consumers. The implication of local authority rates (property tax) is considered. These rates have been ignored in the main economic analysis of the installation. Availability of the machine over the 33-month reporting period (September 1985-May 1988) was over 97%. During this period the WTG produced a total of 368,103 kWh of energy.

14468 (EUR–12283) **Wind energy: European research and development: Contractors' catalogue, 1989.** Caratti, G. (Commission of the European Communities, Brussels (Belgium)); Shock, R.A.W. (eds.). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Commission of the European Communities, Brussels (Belgium). 1990. 120p. Sponsored by Commission of the European Communities, Brussels (Belgium). Source:

OSTI; NTIS (US Sales Only): Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 10.

This booklet presents a summary. at mid-1989 of the participants in. and their contributions to, the Wind Energy R&D program of the Commission of the European Communities. DG 12, Science, Research and Development, Brussels. The contributors to the work encompass a wide range of public and private research institutions throughout the European Community. A list of participants and a short description of the projects being undertaken is included. The current Wind Energy R&D programs may be divided into three parts: Assessment of Resources in Europe, Wind-Generator Experiments and Development of Technologies and Prototypes. 30 figs.

14469 (EUR–12384) **Two 250 KW windturbines and two 600 KW total energy installations.** Commission of the European Communities, Luxembourg (Luxembourg). 1989. 138p. Contract WE 402/85. Source: OSTI; NTIS (US Sales Only).

The project exists of two wind turbines of the type Windmaster, each with a capacity of 250 kW combined with two Total Energy Installations each with an electrical capacity of 600 kW. A technical explanation of the wind turbines and the total energy installations is given. Also reported is the mean output per month the wind turbines and the total energy installation have already provided. The project has been officially delivered on May 1, 1988, although still a significant number of activities had to be finished and all equipment had to be optimised. After the start-up phase a number of break-downs have occurred, which were not anticipated. A description of how these were or are being solved is given. Due to this it is expected that the project will be finished in the spring of 1989. Finally a financial review of the total project is given.

14470 (EUR–12751) **Water pumping system Freiburg: Demonstration project: Final report.** Koethe, H.K. (Fraunhofer-Institut fuer Solare Energiesysteme (ISE), Freiburg im Breisgau (Germany, F.R.)); Roessler, E. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Fraunhofer-Institut fuer Solare Energiesysteme (ISE), Freiburg im Breisgau (Germany, F.R.). 1990. 95p. (In German, English). Sponsored by Commission of the European Communities, Brussels (Belgium). Contract SE/713/84-DE. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 7.50.

This demonstration project was intended to show that photovoltaics and wind energy are mutually complementary and can operate reliably. The aim of the water pumping system in Freiburg was to demonstrate the operation of a stand-alone water supply system using regenerative energy sources, as part of the State Garden Show in 1986. A further aim of this project was to test technology which could form the basis of a technology transfer to developing countries with hot, dry regions. Additionally, it would be demonstrated that such stand-alone systems are simple to install and to run, and a high availability should be achieved. Items included in the paper are listed. (1) Project aim and general description: aim of the project, description of the site, description of the installation, and description of the measurement system. (2) Construction, installation and commissioning: supplies of equipment and services, project management, problems, solutions, successes, modifications, schedule, and costs. (3) Operation and results: operating history, performance, success of the project, and future of the installation. (4) Economic viability: costs of PV generated electricity, and costs of alternative electricity supplies. (5) Publicity, commercialization and other developments: publicity and publications, patent activity, outlook, commercialization, and lessons learned/conclusions. 4 figs., 4 tabs.

14471 (NEI-DK–511) **Preliminary investigation of regulation of number of rotations of wind turbine blades.** Rasmussen, P.; Lakkenborg, J. Nordvestjysk Folkecenter for Vedvarende Energi, Hurup (Denmark). Oct 1990 42p. (In Danish). Contract ENS-UVE-90.0073. Order Number DE91763428. Source: OSTI; NTIS (US Sales Only).

An investigation of whether regulation of the rotation frequency of windmills can contribute to increased production of electricity. The aim was also to develope a computerized control system and a regulation strategy. It was concluded that production was significantly increased where rotation was varied and was regulated in accordance with wind velocity, and that the costs involved are weighed up by the economical advantages. (AB).

14472 (RISO-M–2861) **Wind turbine test Vestas V27-225 kW.** Markkilde Petersen, S. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Oct 1990. 64p. Order Number DE91763376. Source: OSTI; NTIS (US Sales Only).

The report describes fundamental measurements performed on a Vestas-V27-225 kW pitch regulated wind turbine. The measurements carried out and reported here comprises the power output, system efficiency, energy production, transmission efficiency, rotor power, rotor efficiency, air-brakes efficiency, structural dynamics, loads at cut-in and braking, yaw error statistics, flapwise root bending moment and rotor thrust. (author).

14473 (RISO-M–2884) **An aeroelastic model with applications to a two-bladed wind turbine.** Kretz, A.; Rasmussen, F. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Nov 1990. 68p. Order Number DE91763378. Source: OSTI; NTIS (US Sales Only).

Recently the Test Station for Wind Turbines at Risoe has intensified research on types of wind turbines other than the traditonal three-bladed machine; one such type is the two-bladed teetering hub configuration. An aeroelastic mathematical model has been developed, and measurements have been performed on a Windane 12 wind turbine in order to verify the model. The result is a fast converging computer code that easily runs on a PC. A parametric study of the teeter stop stiffness, damping and position shows their strong influence on the structural behavior of the turbine and on yaw stability under skew inflow. The model has been developed in parallel with measurements on a Windane 12 wind turbine, and shows good agreement with the physical behaviour. This report contains a description of the model and an analysis of some fundamental features of the two-bladed teetering rotor design, together with the results of actual measurements on the Windane 12. (author) 4 ills., 36 refs., 12 refs.

14474 (RISO-M–2887) **Structural dynamics of a 100 kW HAWT.** Aagaard Madsen, H. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Feb 1991. 119p. Contract EM-1364/88-3;Contract EN3W-0032-DK. Order Number DE91763386. Source: OSTI; NTIS (US Sales Only).

EFP-88.

The present report is part of the final reporting of a 4 years project on experimental aerodynamics with the objective to identify the main mechanisms controlling the aerodynamic forces on a rotating HAWT blade. The dynamic the measurements are aimed to quantify the importance of 3D flow effects, unsteady effects and rotary wing effects. However, the present report deals mainly with the dynamic response of the turbine but data on the aerodynamic load input and the transfer function between load input and response is also presented. The experimental set-up comprised a 100 kw stall-regulated turbine with a 19 m rotor and operated at two fixed rotational speeds. One of the blades have been rebuild so that local forces on three segments of the blade (each 0.5 m in spanwise width) can be measured. The relative inflow velocity vector to the blade segmants is measured with a five hole pitot tube. The analysis of the flapwise blade root moment response shows that this parameter besides the harmonics of the rotational speed (1p, 2p, 3p and 4p) is influenced by the following four modes (1) first tower bending; (2) and (3) the two asymmetrical rotor modes (yaw and tilt movements) and (4) the symmetrical rotor mode. The standard deviation (Std.Dev) of the tilt moment is 20-30% higher than the Std.Dev. of the yaw moment. A comparison of the response at high and low wind speed conditions shows that the 1p component in the power spectrum of the flapwise blade root moment is more dominant at high wind than at low wind. Finally, the power spectrum of the aerodynamic load input and the power spectrum of the flapwise response minus the inertia force component are in a good agreement at low wind speed. However, at high wind speed the Std.Dev. of the response is 50-100% higher than the Std.Dev. of the load input and stall hysteresis is probably the main cause for this discrepancy. (AB) 5 tabs., 151 ills., 8 refs.

14475 (RISO-M–2894) **Taendpibe wind farm measurements 1988.** Hoejstrup, J.; Noergaard, P. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Dec 1990. 44p. Contract EN3W-0068-DK. Order Number DE91763379. Source: OSTI; NTIS (US Sales Only).

Data from a field program on a wind farm in Denmark is reported. High frequency measurements of windspeeds and directions at several heights were measured inside the windfarm as well as upstream of the farm. Also mean power output and power fluctuation levels were measured. The results have been compared with the simple Risoe PARK model for average power output of a windfarm. The model was shown to be capable of accurately modelling the wind farm output. The turbulence inside the farm was investigated in detail. The average levels of turbulence in such a farm seem to reach an equilibrium level of 20-25% at the highest point of the measurements, 30 m (somewhat above hubheight) and still increasing with height. This level of turbulence could be generated by a freestream roughness length of the order of 0.5 m. The spectral decomposition of the turbulent velocity fluctuations showed that the main amount of excess energy inside the farm compared with upstream, was found at a shallow maximum around 0.1 Hz (or in terms of wavelength around 60 m). The turbulence inside the windfarm could not be described by ordinary homogenous terrain parameterizations, except for the vertical fluctuations that apparently attained a local equilibrium. The horizintal components were far from their equilibrium values. (author).

14476 (RISO-M–2902) **Aerodynamics and structural dynamics of a horizontal axis wind turbine: Raw data overview.** Aagaard Madsen, H. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Feb 1991. 304p. Contract EM-1364/88-3:Contract EN3W-0032-DK. Order Number DE91763387. Source: OSTI; NTIS (US Sales Only).

Appendix to the reports RISO-M-2887 and RISO-M-2903.

The present report is part of of the final reporting of a 4 years project on experimental aerodynamics with the objective to identify the main mechanisms controlling the aerodynamic forces on a rotating HAWT blade. In particular, the measurements are aimed to quantify the importance of 3D flow effects, unsteady effects and rotary wing effects. The objectives of the present report is to present an overview of the raw data obtained during the measurement campaign within the project. In this way it is hoped that this experimental data base can be used for model verification by various people. In particular the measurements of the local, relative inflow velocity vector to the blade and the simultaneous measurement of the local blade segment forces, make the data set suitable for the investigation of unsteady effects such as stall hysteresis and dynamic inflow. Data have been obtained for the turbine in normal as well as in yawed operation. Also the load distribution can be studied on basis of the data set. For each data file a table is shown with the 10 min. average statistics of a major part of the measured parameters. Additionally is also shown for each data file time tracks of the meteorological parameters and of characteristic parameters of the turbine. Finally, the 30 sec. avaerage statistics are summarized in different graphs. (author).

14477 (SL–1251-87126-Vol.1) **Estimation of interactions between the wind turbines in an array, carried out on the basis of measurements on Ebeltoft Moellepark: Text.** Skibsteknisk Laboratorium, Lyngby (Denmark). Aug 1988. 61p. (In Danish). Contract TR-85.194. Order Number DE91763429. Source: OSTI; NTIS (US Sales Only).

Measurements and analysis carried out on Ebeltoft Moellepark, Denmark. The measurements include data on efficiency, wind velocity and direction, and data on the electricity quality. The latter is used to evaluate the effect on the overall electric power network. (CLS).

14478 (SL–1251-87126-Vol.2) **Estimation of interactions between the wind turbines in an array, carried out on the basis of measurements on Ebeltoft Moellepark: Efficiency Characteristics.** Skibsteknisk Laboratorium, Lyngby (Denmark). Aug 1988. 73p. (In Danish). Contract TR-85.194. Order Number DE91763430. Source: OSTI; NTIS (US Sales Only).

Efficiency curves for wind velocity and directions measured at the wind farm, Ebeltoft Moellepark, Denmark are presented. (CLS).

14479 (SL–1251-87126-Vol.3) **Estimation of interactions between the wind turbines in an array, carried out on the basis of measurements on Ebeltoft Moellepark: Data on the electricity quality.** Skibsteknisk Laboratorium, Lyngby (Denmark). Aug 1988. 140p. (In Danish). Contract TR-85.194. Order Number DE91763431. Source: OSTI; NTIS (US Sales Only).

A survey of electricity quality data from measurements on the wind farm, Ebeltoft Moellepark, Denmark is presented. (CLS).

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Refer also to citation(s) 13998, 14026, 14036, 14038, 14391, 14445, 14740, 14748, 14759, 14765

14480 (ANL–90/38) **A theory for fluidelastic instability of tube-support-plate inactive modes.** Cai, Y. (Argonne National Lab., IL (USA). Materials and Components Technology Div.); Chen, S.S.; Chandra, S. Argonne National Lab., IL (USA). Sep 1990. 45p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. Order Number DE91009676. Source: OSTI; NTIS; GPO Dep.

Fluidelastic instability of loosely supported tubes, vibrating in a tube-support-plate (TSP) inactive mode, is suspected to be one of the main causes of tube failure in some operating steam generators and heat exchangers. This report presents a mathematical model for fluidelastic instability of loosely supported tubes exposed to nonuniform crossflow. The model incorporates all motion-dependent fluid forces based on the unsteady flow theory. In the unstable region associated with a TSP-inactive mode, tube motion can be described by two linear models: TSP-inactive mode when tubes do not strike the TSP, and TSP-active mode when tubes do strike the TSP. A bilinear model (consisting of these linear models) presented in this report simulates the characteristics of fluidelastic instability of loosely supported tubes in stable and unstable regions associated with TSP-inactive modes. Analytical results obtained with the model are compared with published experimental data; they agree reasonably well. The prediction procedure presented for fluidelastic instability response of loosely supported tubes is applicable to the stable and unstable regions of the TSP-inactive mode. 25 refs., 21 figs.

14481 (CONF-9004135–2) **A real-time expert system for monitoring and diagnosing fire-tube boilers.** Chatterjee, J. (Institute of Gas Technology, Chicago, IL (USA)); Blazek, C.F.; Schanche, G. Institute of Gas Technology, Chicago, IL (USA). [1990]. 17p. Sponsored by Institute of Gas Technology, Chicago, IL (USA). From 19. annual international programmable controllers conference and exposition IPC^2: expert systems '90; Detroit, MI (USA); 3-5 Apr 1990. Source: OSTI; Institute of Gas Technology, 3424 South State St., Chicago, IL 60616.

An expert system is being developed for the United States Army Corps of Engineers, Construction Engineering Research Laboratory (CERL) by the Institute of Gas Technology (IGT). This paper discusses the second phase of the developmental effort for the expert system, MAD, which optimizes boiler efficiency and minimizes downtime due to unexpected shutdowns and start-up failures. This expert system takes into account various boiler configurations in terms of available sensor information and adopts the most suitable approach for estimating operating efficiency. The main emphasis of this paper will however be on the diagnostic section of the expert system. This rule based diagnostic system which contains over 500 rules has been developed to identify causes of start-up failure and uncontrolled shutdowns. The paper will discuss the most frequently used knowledge engineering techniques adopted while developing the system. In this context, bottlenecks encountered during the knowledge acquisition phase will also be reviewed. Though it is recognized that the success of such techniques is probably domain dependent, the development of generic techniques for diagnosis is a distinct possibility. One such technique of using sequential indicators in a parallel manner will be discussed in detail with specific examples. 4 figs.

14482 (DOE/BP–1479) **Operations, maintenance, and replacement 10-year plan and accompanying technical reports, 1990–1999.** USDOE Bonneville Power Administration, Portland, OR (USA). Oct 1990. 727p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009685. Source: OSTI; NTIS; GPO Dep.

The documents in this binder include Bonneville Power Administration's Operations, Maintenance, and Replacement (OM & R) final 10-Year Plan and ten technical reports produced by work groups who were responsible for providing input to the plan. The technical reports provide background information, current status, and plans for how each OM & R function should be performed in the future. The technical reports represent the combined efforts of the members of the work group and contain their recommendations to management for preferred actions. After careful analyses of the technical reports produced by the work groups, the O & M Management Team identified 12 major areas that required specific decisions. The work groups prepared issue papers for the major recommendations, reviewing and analyzing the various alternatives they considered to be viable. The final 10-Year Plan is not merely a compilation of the technical reports or the issue papers. It represents a mix of those documents and management decisions and, based on various priorities, system requirements and resource availability. The 12 major areas of concern are maintenance backlog, apprentices, dispatcher training, system protection maintenance (SPM) repair, SPM training center, dispatcher training facility, maintenance and space part support, non-electric plant staffing and workload, environment, transmission line maintenance aging facilities, outage data, and replacements. The reports have been processed separately for inclusion on the data base.

14483 (DOE/ET/10815–139) **An investigation into the feasibility of a radiant recuperative air heater for a magnetohydrodynamic/steam power plant.** Boss, W.H.; Babu, S. Tennessee Univ., Tullahoma, TN (USA). Space Inst. Jan 1991. 154p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-79ET10815. (UTSI–89-08). Order Number DE91009058. Source: OSTI; NTIS; GPO Dep.

The ultimate high efficiencies envisioned for a magnetohydrodynamic (MHD)/steam power plant have been based on the development of a regenerative high temperature air heater (HTAH). Oxygen enriched and vitiation heated air has been used in current test facilities and is proposed for early commercial plants to circumvent the costly development of the HTAH for MHD. Since the US DOE Coal Fired Flow Facility (CFFF) routinely conducts proof-of-concept (POC) MHD tests lasting several hundred hours, it was decided that it would be simple and inexpensive to include materials tests to investigate their suitability for either a recuperative or regenerative type high temperature air heater for MHD applications. Although both the regenerator and recuperator required for use in the MHD environment are beyond the state-of-the-art, the recuperator is much less complex operationally and should be less expensive. This interim report identifies a material and recuperator concept that warrants further testing and development based on the test results presented herein. An additional material was also identified which was highly resistant to corrosion and thus may have value as a protective coating. This phase of the study was concerned with the screening of candidate materials on a pass/fail basis, thus, little effort was made toward collecting accurate temperature data for each sample. The next phase will concentrate on acquiring more engineering data on the materials. Measurements will also be made to determine the effectiveness of the recuperator concept. 24 refs., 79 figs., 9 tabs.

14484 (DOE/FE–0216P) **Air-blown Integrated Gasification Combined Cycle demonstration project: Comprehensive report to Congress: Clean Coal Technology Program.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Office of Clean Coal Technology. Jan 1991. 24p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009355. Source: OSTI; NTIS; GPO Dep.

Clean Power Cogeneration, Inc. (CPC) has requested financial assistance from DOE for the design construction, and operation of a normal 1270 ton-per-day (120-MWe), air-blown integrated gasification combined-cycle (IGCC) demonstration plant. The demonstration plant would produce both power for the utility grid and steam for a nearby industrial user. The objective of the proposed project is to demonstrate air-blown, fixed-bed Integrated Gasification Combined Cycle (IGCC) technology. The integrated performance to be demonstrated will involve all the subsystems in the air-blown IGCC system to include coal feeding; a pressurized air-blown, fixed-bed gasifier capable of utilizing caking coal; a hot gas conditioning systems for removing sulfur compounds, particulates, and other contaminants as necessary to meet environmental and combustion turbine fuel requirements; a conventional combustion turbine appropriately modified to utilize low-Btu coal gas as fuel; a briquetting system for improved coal feed performance; the heat recovery steam generation system appropriately modified to accept a NO_x reduction system such as the selective catalytic reduction process; the steam cycle; the IGCC control systems; and the balance of plant. The base feed stock for the project is an Illinois Basin bituminous high-sulfur coal, which is a moderately caking coal. 5 figs., 1 tab.

14485 (DOE/PC/89663–T1) **Development of a coal quality expert: Technical progress report No. 2, [July 1–September 30, 1990].** CQ, Inc., Homer City, PA (USA). 9 Jan 1991. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC22-90PC89663. Order Number DE91008530. Source: OSTI; NTIS; GPO Dep.

Four companies and seven host utilities have teamed with CQ Inc. and C-E to perform the work on this project. The 42-month project will provide the utility industry with a PC expert system to confidently and inexpensively evaluate the potential for coal cleaning, blending, and switching options to reduce emissions while producing lowest cost electricity. Specifically, this project will: enhance the existing Coal Quality Information System (CQIS) database and Coal Quality Impact Model (CQIM) to allow confident assessment of the effects of cleaning on specific boiler cost and performance; and develop and validate a methodology, Coal Quality Expert (CQE) which allows accurate and detailed predictions of coal quality impacts on total power plant capital cost, operating cost, and performance based upon inputs from inexpensive bench-scale tests. During the past quarter, coal cleanability characterization and utility boiler field tests were conducted. Coal characterization studies were performed with the Croweburg Seam coal, obtained from Peabody Coal Company's Rogers County No. 2 Mine located in northeastern Oklahoma. This coal is burned as part of a blend at Public Service Oklahoma's Northeastern Unit 4 (PSO-NE4), a 450-MW unit located at Oologah, Oklahoma. Full-scale combustion tests were initiated at PSO-NE4. Three coal feed scenarios will be evaluated at this site: (1) 100 percent Wyoming Coal (baseline), (2) 90/10 blend of Wyoming and Oklahoma coals, and (3) 70/30 blend of Wyoming and Oklahoma coals. Results to date are given. 3 figs., 5 tabs.

14486 (EUR–11660) **Thermal waste recovery at electric power plants in the European Economic Community: Volume 1: General synthesis, Volume 2: Case studies: Demonstration project, Final report.** Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Potentiel-Energie, 75 - Paris (France). ©1988. 158p. Sponsored by Commission of the European Communities, Brussels (Belgium). 86-B-7031-11-005-17. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; ECU $12.50.

The functioning of any thermal electric power plant (classic or nuclear) results in waste into the atmosphere of large quantities of heat at low temperature levels. The quantities of waste heat rejected by power plants are such that the size of the recovery operation (surface are of greenhouses or basins) is never limited by the waste heat flow. At present, there are 38 operations in service in the EEC nations using thermal waste from electric power plants, and 9 operations are in construction or projects that will soon materialize. The majority of these operations are today purely commercial and mainly concern: horticulture and market gardening in greenhouses, and freshwater aquaculture. The other applications are of much more doubtful profitability (building heating, agriculture), or remain for now still in the experimental stage (seawater

aquaculture, waste heat irrigation, algae culture). The objective of this study is three-fold: to make an exhaustive inventory of all thermal waste recovery operations in service or in construction, and to make a detailed assessment; thanks to this inventory and by means of detailed case studies on the most representative operations, to realize a complete technical and economic analysis of these operations; and in view of the joint results of the assessment of operations and the technical and economic analysis, to extricate the technical and economic options to promote. Volume 2 contains 10 case studies.

14487 (VTT-TUTK–692) **Material property decradation of steam turbine rotors in long-term operations.** McNiven, U. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio); Rahka, K.; Rintamaa, R.; Auerkari, P. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Jun 1990. 42p. (In Finnish). Order Number DE91763456. Source: OSTI; NTIS (US Sales Only).

Main factors limiting the life of a HP rotor are thermal fatigue and possibly creep fatigue. The result can be a catastrophic fracture, if the growing defects are not detected in time. Fatigue and/or stress corrosion limit the life-time of LP rotors. The final result is again a fast fracture and the rotor will be destroyed if growing defects are not detected early enough. The state of material properties can be determined by nondestructive testing, material testing, by analyzing the service history and the damages.

14488 High temperature insulation. Kamstrup-Larsen, J. 24 Jul 1990. Filed date 13 Dec 1989. Canada Patent patent application 2005329. 10p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A method is provided for heat insulating the surface of a high temperature device such as a power turbine. Without insulation, the surface of the turbine may rise to 500°C during operation. The object of insulating a turbine is to maintain the surface temperature of the turbine housing to allow operators to work comfortably in close proximity to the turbine, to maintain a high turbine efficiency, obtain a satisfactory heat economy. It is also desirable to maintain a constant temperature in order to avoid undesired stress in the turbine material. Known methods of insulating power station turbines take up to a week for removal and 2 weeks for replacement, during periods of checkup and repairs. Because of the large cost of such turbines, it is essential that such downtime be reduced as much as possible. The object of the following invention is to provide a satisfactory turbine insulation which is easy and rapid to install and remove. The invention comprises mounting a shell at a distance from the surface to be insulated and packing the space between the shell and the surface with separate insulation elements, each comprising a cover of a heat-resistant material and containing loose mineral fiber material. The shell may consist of a thin, readily workable material such as a metal sheet. The cover material may consist of fibers of nylon, glass, or ceramic, or of a thin perforated metal foil. The loose mineral fiber is preferably mineral wool. The heat insulation of the invention may be reused if the insulation layer has to be dismantled. The insulation of this invention is also applicable to boilers. 2 figs.

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Refer also to citation(s) 13996, 13997, 13998, 14002, 14009, 14026, 14482, 14484, 14485, 14748, 14894, 15259

14489 (ANL/CP–72548) **Combined NO_x/SO_2 removal in spray-dryer FGD systems.** Livengood, C.D. Argonne National Lab., IL (USA). [1991]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-910331–1: 5. symposium on integrated environmental control for energy systems, New Orleans, LA (USA), 4-5 Mar 1991). Order Number DE91008835. Source: OSTI; NTIS; GPO Dep.

A combination of modified process conditions and addition of caustic soda to a lime-based spray-dryer system was evaluated for its value in promoting combined NO_x/SO_2 removal from flue gas resulting from the combustion of high-sulfur coal. Small-scale tests at the Pittsburgh Energy Technology Center identified key process parameters. Subsequently, two test series, each about one month in duration, were carried out at Argonne National Laboratory in 1986 and 1988 using a commerical-scale (20 MW electric equivalent) spray-dryer/fabric-filter system. Sprayer-dryer outlet temperature was identified as a key factor, with NO_x removal becoming significant above about 180 F and gradually increasing up to the maximum temperature investigated (210 F). No upper limit on removal with increasing temperature was observed. Removal of NO_x was strongly proportional to baghouse filter-cake thickness; nearly all NO_x removal occurred in the baghouse, with a small net production of NO_2(<15 ppm). The NO_x removal was also proportional to the SO_2/NO_x ratio, with little NO_x observed at SO_2/NO_x ratios less than 2:1. Caustic soda addition improved NO_x removal, at least partially through creation of a more porous and reactive filter cake. Steady-state removals of 70% for SO_2 and 35% for NO_x were easily attained. 10 refs., 9 figs., 3 tabs.

14490 (DOE/FE–0211P) **Comprehensive Report to Congress Clean Coal Technology Program: Healy Clean Coal Project: A project proposed by: Alaska Industrial Development and Export Authority.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Office of Clean Coal Technology. Jan 1991. 35p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91008637. Source: OSTI; NTIS; GPO Dep.

In September 1988, Congress provided $575 million to conduct cost-shared Clean Coal Technology (CCT) projects to demonstrate technologies that are capable of retrofitting or repowering existing facilities. One of the 13 projects selected for funding is the Healy Clean Coal Project proposed by the Alaska Industrial Development and Export Authority (AIDEA). This project will demonstrate the combined removal of SO_2, NO_x, and particulates from a new, 50 megawatt electric (MWe) coal-fired power plant using both innovative combustion and flue gas cleanup techniques. Coal provided by the Usibelli Coal Mine, adjacent to the project site, will be pulverized and burned at the new facility to generate high-pressure steam. The high-pressure steam will be supplied to a steam turbine generator to produce electricity. Emissions of SO_2 and NO_x from the plant will be controlled using TRW's entrained combustor with limestone injection in conjunction with a boiler designed by Foster Wheeler. Further SO_2 and particulate removal will be accomplished using the Activated Recycle Spray Dryer Absorber System developed by Joy Technologies, Inc. The innovative concept to be demonstrated is the reuse of unreacted lime, which contains minimal fly ash, in the second-stage SO_2 removal. 6 figs.

14491 (DOE/FE–0213P) **Commercial demonstration of the NOXSO SO_2/NO_x removal flue gas cleanup system: Comprehensive report to Congress: Clean Coal Technology program.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Office of Clean Coal Technology. Jan 1991. 39p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91008638. Source: OSTI; NTIS; GPO Dep.

This project proposed by MK-Ferguson will demonstrate the simultaneous removal of SO_x and NO_x from flue gas by a regenerable sorbent. It will also demonstrate the ability of the NOXSO process to destroy the evolved NO_x and to recover elemental sulfur from the SO_2 in the flue gas. In this project, the flue gas leaving the electrostatic precipitator (ESP) will be cooled by in-duct humidification and then routed to the fluid bed adsorbers, where SO_2 and NO_x will be adsorbed by the sorbent. The cleaned flue gas is then routed to the existing stack. The sorbent is continuously regenerated in a series of steps, each of which is carried out in a separate vessel. The NO_x liberated by heating is returned with the combustion air to the boiler. The H_2S and SO_2 are sent to a Claus plant where they react in the presence of a catalyst to form elemental sulfur – a marketable by-product. The NOXSO process removes over 90% of the SO_2 and up to 70% of the NO_x from the incoming flue gas while generating no significant quantities of solid or liquid wastes. The project will be conducted at Ohio Edison's Niles Plant Unit 1, a 108 net megawatt electric (MWe) pulverized coal-fired cyclone boiler in Trumbull County, Ohio. This project scale will demonstrate the commercial applicability of the NOXSO process. 5 figs., 1 tab.

14492 (DOE/PC/79796–T10) **Enhancing the use of coals by gas reburning-sorbent injection: Quarterly report No. 13, October 1–December 31, 1990.** Energy and Environmental Research

Corp., Irvine, CA (USA). 27 Jan 1991. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC22-87PC79796. Order Number DE91009499. Source: OSTI; NTIS; GPO Dep.

The objective of this project is to evaluate and demonstrate a cost effective emission control technology for acid rain precursors, oxides of nitrogen (NOx) and sulfur (SOx), on two coal fired utility boilers in Illinois. The units selected are representative of pre-NSPS design practices: tangential and cyclone fired. Work on a third unit, wall fired, has been stopped because of funding limitations. The specific objectives are to demonstrate reductions of 60 percent in NOx and 50 percent in SOx emissions, by a combination of two developed technologies, gas reburning (GR) and sorbent injection (SI). With GR, about 80-85 percent of the coal fuel is fired in the primary combustion zone. The balance of the fuel is added downstream as natural gas to create a slightly fuel rich environment in which NOx is converted to N_2. The combustion process is completed by overfire air addition. SOx emissions are reduced by injecting dry sorbents (usually calcium based) into the upper furnace. The sorbents trap SOx as solid sulfates that are collected in the particulate control device. This project is conducted in three phases at each site: (1) Design and Permitting, (2) Construction and Startup, and (3) Operating, Data Collection, Reporting and Disposition. Current status of the project at the two remaining sites is described.

14493 (DOE/PC/79798–T10) **Environmental monitoring for the DOE coolside and LIMB demonstration extension projects: Final report for the period of October, November, December 1989 and January 1990.** White, T. (Radian Corp., Research Triangle Park, NC (USA)); Parrish, C. Babcock and Wilcox Co., Barberton, OH (USA). Domestic Fossil Operations; Radian Corp., Research Triangle Park, NC (USA). Dec 1990. 57p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC22-87PC79798. Order Number DE91008958. Source: OSTI; NTIS; GPO Dep.

The purpose of this document is to present environmental monitoring data, collected during the Department of Energy Limestone Injection Multistage Burner (DOE LIMB) Demonstration Project Extension. These data were collected by implementing the Environmental Monitoring Plan (EMP) for the DOE LIMB Demonstration Project Extension, dated August 1988. This is the first in a series of EMP status reports to be submitted throughout the duration of the DOE project. The data presented in this report were generated from October to December 1989, and January 1990. The DOE project is an extension of the Environmental Protection Agency's (EPA) original LIMB Demonstration. The program is operated under DOE's Clean Coal Technology Program of "emerging clean coal technologies" under the categories of "in boiler control of oxides of sulfur and nitrogen" as well as "post-combustion clean-up." The objective of the LIMB program is to demonstrate the sulfur dioxide (SO_2) and nitrogen oxide (NO_x) emission reduction capabilities of the LIMB system. The LIMB system is a retrofit technology to be used for existing coal fired boilers equipped with electrostatic precipitators (ESPs). 4 figs., 7 tabs.

14494 (DOE/PC/88850–T2) **Fundamental investigation of duct/ESP phenomena: Topical report No. 6, First Generation Duct Injection Model.** Vlachos, N.S.; Mahaffey, W.A.; Daley, P.L. CHAM of North America, Inc., Huntsville, AL (USA). Dec 1990. 196p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-88PC88850. Order Number DE91007968. Source: OSTI; NTIS; GPO Dep.

This report describes in detail the First Generation Duct Injection Model developed for the analysis of the fundamental processes of flue gas desulfurization by sorbent injection. The model is a two- and three-dimensional, multiphase reacting flow analyzer using computational fluid dynamics methods. The gaseous phase is solved in an Eulerian frame while the droplets or particles are tracked in a Lagrangian frame. The model has an associated pre-processor which allow easy problem set up by the use without in-depth knowledge of computational fluid dynamics. The aerodynamics of the First Generation Duct Injection Model have been successfully validated with a number of test cases for which experimental data are available. Data from the Meredosia pilot plant humidification tests have been used to validate the gas and droplet dynamics of the model with good agreement. Comparison of SO_2 removal results using the present model (with one injector) and the one-dimensional model previously developed indicated lower SO_2 capture rates for the present multi-dimensional flow model. The differences are mainly due to the more realistic nature of the multi-dimensional flows handled by the First Generation Duct Injection Model. 24 refs., 49 figs.

14495 (DOE/PC/88889–T7) **Proof-of-concept testing of the advanced NOXSO flue gas cleanup process: Quarterly technical progress report, October 1–December 31, 1990.** Gilbert, R.L. MK-Ferguson Co., Cleveland, OH (USA). [1990]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-89PC88889. Order Number DE91009503. Source: OSTI; NTIS; GPO Dep.

The objective of this project is to demonstrate the potential for application of the NOXSO Flue Gas Treatment (FGT) technology to coal-fired utility boilers in the 1990s. To accomplish this, the NOXSO team will design, construct, operate, and test a proof-of-concept scale NOXSO test facility at Ohio Edison's Toronto Station. The goal of this test is to obtain the engineering data required to prepare a cost-effective design of a commercial scale NOXSO process module at an acceptable level of technical risk. A secondary goal of the test is to optimize process performance, i.e., achieve 90% removal of SO_2 and NO_x from the flue gas at the lowest possible cost, while maintaining the high level of system reliability dictated by the utility market. The detailed engineering effort, Task 2.3, was completed this quarter. The procurement effort, Task 2.4, is substantially complete. Approximately 95% of the equipment and materials have been purchased and about 75% have been received. The construction work, Task 2.5, was 43% complete in December. We are planning to be about 70% complete by the end of March. The NOXSO team members continued to support the project. NOXSO has been assembling the process monitoring equipment and preparing the startup plan. W. R. Grace is continuing to manufacture the sorbent. Ohio Edison has been providing construction assistance at the project site.

14496 (ETDE/NL-mf–1760528) **Demonstration project $DeNO_x$: Measurement program summary interim report (part 1) 65 MWe DeNOsub x (selective catalytic reduction of NOsub x) EPON-plant Gelderland, unit G12.** Nederlandse Maatschappij voor Energie en Milieu BV (NOVEM), Sittard (Netherlands). 1990 8p. (In Dutch). Order Number DE91760528. Source: OSTI; NTIS (US Sales Only).

This interim report is related to the demonstration project 'Selective catalytic reduction of NO_x'. After the introduction and a description of the demonstration project a summary is given of the measurements, reports, inspections and operational experiences with regard to the title demonstration project. Some interim conclusions are given. 7 figs.

14497 (NEI-DK–509) **Temperature conditioning of flue gas when measuring NH_3 concentrations.** FLS Airloq A/S, Valby (Denmark). Jan 1991 64p. (In Danish). Contract ENS-1323/90-0023. Order Number DE91763425. Source: OSTI; NTIS (US Sales Only).

EFP-90.

Stricter demands for reduction of nitrogen oxides emission have, in relation to $DeNO_x$ systems, created the need for continuous measurement of ammonia. NH_3 is a gas which is easily adsorbed on solid substances and this has been investigated with temperature conditioning of the flue gas. A theoretical analysis describes the chemical and physical processes involved in this temperature conditioning, and recommends materials to choose, temperature profiles and pressure reduction in test taking systems. Experiments were carried out where the flue gas was conditioned from 400 degrees centigrade with 1 Bar with a high concentration of fly ash, upto 120 degrees centigrade and 10 mBar without fly ash. In the case of an artificially produced flue gas, containing additives of ammonia, water, sulphur dioxide and fly ash, the catalytic burning and adsorption of ammonia was investigated at varying temperatures and lengths of time in the sampling system. (AB).

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14498 (ANL/CP–72714) **DSM as an acid rain control strategy.** Bernard, M.J.; South, D.W. Argonne National Lab., IL (USA). [1991]. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-9104205–1: Synergic resources conference, Arlington, VA (USA), 22-24 Apr 1991). Order Number DE91009887. Source: OSTI; NTIS; GPO Dep.

This paper draws on an examination by Argonne National Laboratory (ANL) of demand-side strategies and their role in reducing acid rain precursor emissions contained in State of Science/ Technology Report 25, Technologies and Other Measures for Controlling Emissions: Performance, Costs, and Applicability, prepared for the National Acid Precipitation Assessment Program. This examination consisted of an extensive literature search and a comprehensive analysis to identify the potential for end-use load management, i.e., demand-side management (DSM), to reduce power plant emissions. The analysis concluded that a combination of installing cost effective power-plant emission control technologies, implementing cost effective DSM (both conservation and load-shifting/shaping), and pursuing environmental dispatch (which may or may not be cost effective, depending on the area) will produce a net reduction in sulfur dioxide (SO_2) and nitrogen oxides (NO_x) emissions and reduce the need for new generating capacity, especially in the near term. The steps of the analysis conducted and rationale for the conclusions are summarized. 31 refs., 4 figs., 2 tabs.

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Refer also to citation(s) 14617, 14709, 14714, 14740, 15667

14499 (INIS-mf–12805) **Progress of nuclear safety research, 1990.** Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment. Jul 1990 110p. Order Number DE91755883. Source: OSTI; NTIS (US Sales Only); INIS.

Since the Japan Atomic Energy Research Institute (JAERI) was founded as a nonprofit, general research and development organization for the peaceful use of nuclear energy, it has actively pursued the research and development of nuclear energy. Nuclear energy is the primary source of energy in Japan where energy resources are scarce. The safety research is recognized at JAERI as one of the important issues to be clarified, and the safety research on nuclear power generation, nuclear fuel cycle, waste management and environmental safety has been conducted systematically since 1973. As of the end of 1989, 38 reactors were in operation in Japan, and the nuclear electric power generated in 1988 reached 29 % of the total electric power generated. 50 years have passed since nuclear fission was discovered in 1939. The objective of the safety research at JAERI is to earn public support and trust for the use of nuclear energy. The overview of the safety research at JAERI, fuel behavior, reliability of reactor structures and components, reactor thermal-hydraulics during LOCA, safety assessment of nuclear power plants and nuclear fuel cycle facilities, radioactive waste management and environmental radioactivity are reported. (K.I.).

14500 (INIS-SU–231, pp. 50-54) **Comparison of different type reactors according to the criterion of tritium radiation.** Abolmasov, Yu.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

The degree of radiation hazard for personnel of NPPs with the WWER, RBMK, VK and BN type reactors under leaks of water contaminated by tritium to serviced rooms is determined. Tritium production and release to environment is forecasted taking into account paces of nuclear power development. It is proved that under normal operation of technological equipment tritium don't create real radiation hazard for personnel. At present the amount of tritium escaping to environment from NPPs the world over constitutes about 12.6 PBg/yr (0.34 MCi/yr). About 2/3 of this amount is contributed by the PWR and WWER type reactors. By 1990 the tritium amount will increase up to 48PBg/yr (1.3 MCi/yr).

14501 (INIS-SU–231, pp. 57-60) **Nuclear power plants as ^{14}C generators.** Popov, S.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Processes of ^{14}C generation in nuclear power reactors of different types are considered. Data on ^{14}C generation rates in coolants, moderators and fuels of the WWER-440, RBMK-1000, AST-1 coolant and moderator is ditolyl methane $C_{15}H_{16}$, BWR, PWR, MAGNOX, FBR reactors to this or that extent produce ^{14}C. A conclusion is made that for all types of reactors decrease of nitrogen quantity in a core will cause decrease of ^{14}C generated and released into environment.

2101 Power Reactors, Nonbreeding, Light-Water Moderated, Boiling Water Cooled

Refer also to citation(s) 14310, 14564, 14565, 14623, 14634, 14640, 14642, 14643, 14645, 16021

14502 (JAERI-M–90-205) **Mechanical properties of JPDR biological shield concrete.** Idei, Yoshio (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Kamata, Hiroshi; Akutsu, Youichi; Onizawa, Kunio; Nakajima, Nobuya; Sukegawa, Takenori; Kakizaki, Masayoshi. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 70p. (In Japanese). Order Number DE91767887. Source: OSTI; NTIS (US Sales Only); INIS.

Plant life of nuclear power plant will be determined by the aging degradation of main components and structures because of the difficulty and the cost of the replacement. These components are the reactor pressure vessel, concrete structures and cables. Authors have performed the investigation of JPDR biological shield which was the succeeded in first generating electricity in Japan and is now being decommissioned in JAERI. The test core samples were bored from the shield concrete and tested to obtain the mechanical properties. Test results are summarized as below, (1) Peak value of fast neutron dose was estimated as 1×10^{18} n/cm^2 which is equivalent to the dose at the end of life for commercial power reactor. (2) Averaged compressive strength of all specimens had been increased about 20 % compared with initial design strength. (3) It was identified that the compressive strength had a little trend to increase with the increase of neutron dose within the dose range obtained in this study. (4) Tensile strength, Elastic modulus and Poisson's ratio showed little effect of neutron dose. (5) It was suggested that the inside and the mid-section liners were effective to keep the water in concrete and to avoid the reduction in strength. (author).

14503 (RISO-M–2892) **Pin power reconstruction in COSIMA.** Hoejerup, C.F. Risoe National Lab., Roskilde (Denmark). Nuclear Safety Research Dept. Sep 1990. 17p. Order Number DE91624974. Source: OSTI; NTIS (US Sales Only); INIS.

The BWR core simulator code, COSIMA, has been extended with 3 new subroutines, PINPOW, COEFF1, and COEFF2, making it possible to extract single fuel pin powers from the nodal reactor calculations. The methods used are described. (author).

2102 Power Reactors, Nonbreeding, Light-Water Moderated, Nonboiling Water Cooled

Refer also to citation(s) 14262, 14263, 14310, 14541, 14564, 14565, 14569, 14572, 14585, 14589, 14601, 14606, 14614, 14616, 14618, 14619, 14623, 14634, 14639, 14640, 14642, 14643, 14644, 14645, 16021

14504 (DOE/ET/34212–58) **Qualification of the B and W Mark B fuel assembly for high burnup and development of an advanced extended burnup fuel assembly design incorporating uranie-gadolinia: Project summary report.** Newman, L.W. B and W Fuel Co., Lynchburg, VA (USA); Babcock and Wilcox Co., Lynchburg, VA (USA). Research and Development Div.; Babcock and Wilcox Co., Alliance, OH (USA). Contract Research Div.; Duke Power Co., Charlotte, NC (USA). Feb 1991. 58p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-78ET34212. (BAW–1681-11). Order Number DE91009104. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Babcock & Wilcox Company, Duke Power Company, and the United States Department of Energy participated in two extended burnup projects. Under the first project, standard Mark B fuel assemblies were irradiated and examined after three, four, and five cycles of operation to provide fuel performance data at extended burnup, and oxide thicknesses were measured and evaluated for fuel rods with burnups up to 50,000 MWd/mtU. The second project was to develop, irradiate, and examine an advanced fuel assembly design for pressurized water reactors. The advanced fuel assembly used a UO_2-Gd_2O_3 burnable absorber/fuel mixture with other state-of-the-art fuel performance and design features that enhance uranium utilization such as annular pellets, annealed guide tubes, Zircaloy intermediate space grids, and a removable upper end fitting. 61 refs.

14505 (DOE/NE/34082–T16) **Nondestructive examinations of BN3 fuel rods after fast operational transients in BR2: TRIBULATION Project.** van Outryve d'Ydewalle, B. Belgonucleaire SA, Brussels (Belgium). Aug 1984. 38p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–84/28). Order Number DE91008302. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the execution of the following activities, made in the framework of the TRIBULATION program: fast operational transient on one experimental fuel rod fuel from group BN3, in the BR2 reactor at Mol – Belgium; and intermediate examinations at Mol – Belgium of this fuel rod from group BN3 after transient. The group BN3 includes the fuel rods 13 to 15 of the test matrix. For these three fuel rods, details on irradiation history and non-destructive post-irradiation examinations before transient testing are given. 3 refs., 10 figs., 9 tabs.

14506 (DOE/NE/34082–T22) **BR3 first phase irradiation data and intermediate examinations of BN1 fuel rods: TRIBULATION Project.** Lippens, M.; van Outryve d'Ydewalle, B.; Winne, C. Belgonucleaire SA, Brussels (Belgium). Mar 1982. 91p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–82/13). Order Number DE91008308. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the execution of the following activities, made in the framework of the TRIBULATION program: pre-irradiation of experimental fuel rods, group BN1, in the BR3 reactor at Mol-Belgium; and interim examinations at Mol-Belgium of pre-irradiated fuel rods, group BN1. The group BN1 includes the fuel rods 1, 2, 3 and 4 and the test matrix. For these four rods, one provides in the present report details on irradiation history and non-destructive post-irradiation examinations. 7 refs., 36 figs., 29 tabs.

14507 (DOE/NE/34082–T23) **Intermediate neutronic report after the BN1 rods irradiations in the BR3/4C cycle: TRIBULATION Project.** Maldague, T. Belgonucleaire SA, Brussels (Belgium). Aug 1986. 30p. Sponsored by USDOE, Washington. DC (USA). DOE Contract FG01-82NE34082. (TR–86/52). Order Number DE91008309. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Two BN1 rods (3–47 and 3–342) were irradiated in the second half of the cycle 4C. They were previously irradiated in the cycle BR3/4B. During core 4C, they were irradiated in the assemblies WIRR (3–47) and W3RR (3–342). The positions of these assemblies in the core are provided. The locations of the rods in the assemblies are provided and the correspondence between the position number of the rods in the assemblies, the rod number in the TRIBULATION matrix and the rod identification number is given. Irradiation data and calculation methods are also discussed. 1 ref., 5 figs., 18 tabs.

14508 (DOE/NE/34082–T29) **Fabrication and characterization of FRAGEMA design fuel rods (Standard Pellets): TRIBULATION Project.** Floze, J.C. Belgonucleaire SA, Brussels (Belgium). Oct 1983. 51p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–84/25A). Order Number DE91008322. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report documents the fabrication and characterization of 6 FRAGEMA-design fuel rods supplied to the TRIBULATION Project (TRIBULATION matrix; numbers 29 to 34). Fuel rods being supplied to the TRIBULATION Project were initially designed and characterized for an irradiation program in BR3 reactor in Mol (Belgium). These rods are essentially FRAGEMA 17 × 17 design. The exceptions are as follows: fuel rod length and rod free volume (for compatibility with BR3 fuel assemblies), plenum length, initial U_{235} enrichment, and the top and bottom end plugs (BR3 design). The identification of the 6 FGA fuel rods (standard pellets) supplied to the TRIBULATION Project are indicated. The 6 fuel rods were removed from two assemblies respectively C9 and C12 at the end of cycle BR3/4C. The rods initially pressurized with helium to 31 bar had an initial enrichment of 4.95 % U235. The principal design parameters concerning these rods are provided. 12 figs., 15 tabs.

14509 (DOE/NE/34082–T36) **Final non destructive examinations on the BN1 fuel rod numbers 3 and 4 after their second irradiation phase: TRIBULATION Project.** Boulanger, D. Belgonucleaire SA, Brussels (Belgium). Jul 1987. 40p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–87/56). Order Number DE91008329. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the following items, within the framework of the TRIBULATION program: recall of the irradiation conditions in cycles 4C and $4D_1$ of BR3 reactor; and results of the non destructive examinations performed after cycle $4D_1$. The BN1 group includes the fuel rods 1 to 4 of the test matrix. The four rods were filled with pellets enriched to 8.25 w/o U5. The present report only concerns rods 3–47 (3) and 3–342 (4), which have undergone a second irradiation phase in cores 4C (second part) and $4D_1$ of the BR3 reactor. A diagram of the BN1 fuel rod identification, irradiation and examinations performed to date is provided. 6 refs., 16 figs., 6 tabs.

14510 (DOE/NE/34082–T37) **Nondestructive examinations of W3 fuel rods after fast operational transients in BR2: TRIBULATION Project.** van Outryve d'Ydewalle, B. Belgonucleaire SA, Brussels (Belgium). Aug 1984. 76p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–84/31). Order Number DE91008330. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the execution of the following activities, made in the framework of the TRIBULATION program: fast operational transients on four experimental fuel rods from group W3, in the BR2 reactor at Mol-Belgium; and intermediate examinations at Mol-Belgium of these fuel rod from group W3 after transient. The group W3 includes the fuel rods 22 to 28 of the test matrix. For these six fuel rods, details on irradiation history and non-destructive post-irradiation examinations before transient testing are given. 3 refs., 38 figs., 18 tabs.

14511 (DOE/NE/34082–T38) **Nondestructive examinations of W1 fuel rods after fast operational transients in BR2: TRIBULATION Project.** van Outryve d'Ydewalle, B. Belgonucleaire SA, Brussels (Belgium). Aug 1984. 39p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–84/29). Order Number DE91008331. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the execution of the following activities, made in the framework of the TRIBULATION program: fast operational transient on one experimental fuel rod from group W1, in the BR2 reactor at Mol-Belgium; and intermediate examinations at Mol-Belgium of this fuel rod from group W1 after transient. The group W1 includes the fuel rods 9 to 12 of the test matrix. For these four fuel rods, details on irradiation history and non-destructive post-irradiation examinations before transient testing are given. 3 refs., 10 figs.,9 tabs.

14512 (DOE/NE/34082–T40) **Postirradiation examination of seven BR3 fuel rods comprising the second part of the TRIBULATION Program: TRIBULATION Project.** Garlick, A.; Goldsmith, L.A.; Kennedy, P.D.; Thompson, J.F.W.; Walters, C.L.; Manley, A.J. Belgonucleaire SA, Brussels (Belgium). Aug 1987. 73p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–87/65). Order Number DE91008333. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report describes the post irradiation examination at WNL of 7 fuel rods from the Tribulation programme. All rods had been given a base irradiation in the BR3 PWR following which 3 rods were subjected to a power transient in the BR2. Three rods, only one of which had received a transient, were then irradiated for a further period in the BR3 reactor. All rods reached a mean burn-up of between 33–45 GWd/tU. The rods are of standard BR3 dimensions (1136 mm long, 9.50 mm nominal diameter). Fabrication data have been reported. Irradiation histories are also presented. Details are given of the results of non-destructive testing of all 7 rods and of the destructive examination of 3 selected rods (one ramped and two unramped). 7 refs., 27 figs., 21 tabs.

14513 (DOE/NE/34082–T47) **Final non destructive examinations on FGA1 fuel rods after irradiation in BR3/4D_2 core: TRIBULATION Project.** Boulanger, D. Belgonucleaire SA, Brussels (Belgium). Aug 1988. 58p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–88/70). Order Number DE91008340. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the results of the final nondestructive examinations performed on four experimental fuel rods of the FGA1 group. The FGA1 group includes the fuel rods 29 to 34 of the test matrix. A diagram of the FGA1 fuel rod identification, irradiations and examinations performed within the framework of the TRIBULATION program is provided. This report only concerns rods 31 to 34 which have been submitted to a last irradiation phase during BR3/4D_2 cycle, and to subsequent nondestructive examinations. 8 refs., 33 figs., 10 tabs.

14514 (DOE/NE/34082–T48) **Final nondestructive examinations on the BN3 fuel rod numbers 14 and 15 after their second irradiation phase: TRIBULATION Project.** Boulanger, D. Belgonucleaire SA, Brussels (Belgium). Jul 1987. 37p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–87/57). Order Number DE91008341. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the following items, within the framework of the TRIBULATION program: recall of the irradiation conditions in cycle 4D_1 of the BR3 reactor; and results of the non destructive examinations performed after cycle 4D_1. The BN3 group includes the fuel rods 13, 14 and 15 of the test matrix. The three rods are unpressurized and filled with pellets enriched to: 8.25 w/o U5 for rod 1–625; 5.76 w/o U5 for rods 1–10 and 1–610. The present report only concerns rods 1–10 (14) and 1–610 (15), which have undergone a second irradiation phase in cycle 4D_1 of the BR3 reactor. A diagram of the BN3 fuel rod identification, irradiations and examinations performed to data is provided. 8 refs., 17 figs., 6 tabs.

14515 (DOE/NE/34082–T49) **Final non destructive examinations on the W1 fuel rod numbers 9, 10, 11 and 12 after their second irradiation phase: TRIBULATION Project.** Boulanger, D. Belgonucleaire SA, Brussels (Belgium). Jul 1987. 51p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–87/58). Order Number DE91008342. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This topical report provides the information relative to the following items, within the framework of the TRIBULATION program: recall of the irradiation conditions in cycles 4C and 4D_1 of the BR3 reactor; and results of the non destructive examinations carried out after cycle 4D_1. The W1 group includes the fuel rods 9 to 12 of the test matrix. Three of the rods (10, 11 and 12) are filled with short pellets (6.7 mm length), while the fourth (rod 9) is filled with pellets twice as long (13.4 mm). Moreover, two rods (10 and 11) contain a Zr4 nickel-plated hollow cylinder, inserted in the plenum spring and acting as tritium getter. The initial enrichment was 5.74 w/o U5. The four rods underwent a second irradiation phase in cores 4C (second part) and 4D_1 of the BR_3 reactor. The present non destructive examinations precede a: destructive examination campaign on rod 9; and storage of rods 10, 11 and 12. A diagram giving the W1 fuel rod identification, irradiations and examinations performed to data is provided. 7 refs., 29 figs., 8 tabs.

14516 (DOE/NE/34082–T50) **Intermediate neutronic report after the BBR1 and BBR2 rods irradiations in the BR3/4C: TRIBULATION Project.** Maldague, Th. Belgonucleaire SA, Brussels (Belgium). Aug 1986. 77p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–86/53). Order Number DE91008343. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Two groups of four fresh rods (BBR1 and BBR2) were irradiated in the BR3/4C core (whole cycle). The positions of the assemblies containing the BBR rods are provided for the cycle BR3/4C. The locations of the rods in the assemblies are shown and the correspondence between the position number of the rods in the assemblies, the rod number in the TRIBULATION matrix and the rod identification number are given. Irradiation data and calculation methods are also presented. 5 figs., 60 tabs.

14517 (DOE/NE/34082–T51) **BR3 first phase irradiation data and intermediate examinations of BN3 fuel rods: TRIBULATION Project.** Lippens, M.; van Outryve d'Ydewalle, B.; Winne, C. Belgonucleaire SA, Brussels (Belgium). Mar 1982. 104p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-82NE34082. (TR–82/12). Order Number DE91009668. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The topical report provides the information to the execution of the following activities associated with the Tribulation program: preirradiation of experimental BN3 fuel rods in the BR-3 reactor at Mol-Belgium and interim examination of the rods. The irradiation history is discussed with respect to rod identification, neutronic calculations, irradiation data, and thermohydraulics. The interim examinations are described with respect to visual examination, dimensional controls, neutron radiography, gamma scanning, eddy current testing, and results are presented. 7 refs.. 29 figs., 49 tabs. (MB)

14518 (IAEA-TECDOC–586) **Simulation of a loss of coolant accident with rupture in the steam generator hot collector: Results of the third standard problem exercise on the simulation of loss of coolant accidents.** International Atomic Energy Agency. Vienna (Austria). Mar 1991. 319p. Order Number DE91625970. Source: OSTI; NTIS (US Sales Only); INIS.

The Central Research Institute for Physics of the Hungarian Academy of Sciences designed and constructed the PMK-NVH test facility, a scaled down model of the WWER-440 Paks nuclear power plant. Hungary made the PMK-NVH facility available to the IAEA. The IAEA, having identified the need for experimental data due to the difficulties of building integral test facilities and the high costs of these experiments, has accepted the offer of the Hungarian Academy of Sciences and has organized three standard problem exercises. In these exercises, experimental data from the simulation of loss of coolant accidents were compared with analytical predictions of the behaviour of the facility, calculated with computer codes. The third standard problem exercise involved a test, in which the rupture was simulated to occur at the top of the hot collector of the steam generator, therefore creating a leak from primary to secondary side. Both hydroaccumulators and high pressure injection were allowed to actuate as prescribed in the actual plant. Eighteen organizations from 15 Member States took part in the exercise presenting pre-test and some post-test analyses which were discussed in a final meeting in Vienna in August, 1990. This document presents a complete overview of the third standard problem exercise, including description of the facility, the experiment,

the codes and models used by the participants and a detailed intercomparison of calculated and experimental results. It is recognized that code assessment is a long process which involves many interrelated steps; therefore, no general conclusion or optimum code or best model was reached. However, the exercise was recognized as an important contributor to code validation. 42 refs, figs and tabs.

14519 (INIS-mf–12182) **Kernkraftwerk Obrigheim GmbH. Annual report 1989.** Koerner, C. (comp.). Kernkraftwerk Obrigheim GmbH (Germany, F.R.). 1990 79p. (In German). Order Number DE91764345. Source: OSTI; NTIS (US Sales Only); INIS.

The Obrigheim nuclear power station was operated at full load during the year 1989: 7.756 operating hours produced electrical energy of 2.689 GWh. This is the fifth best annual result during Obrigheim's operating period. Since commissioning in October 1968, 154.866 hours of operation have generated 52.125 GWh (gross) and from test operation in March 1969 until the end of 1989, 154.086 hours of operation have generated 52.013 GWh. This is an availability of power of 82.1% in this period and a time availability of 84.4%. In 1988, the plant was shut down for 927 hours for the 20th refueling including testing, inspection and repair work. Apart from refueling, the plant had a good time availability and therefore contributed 5% to the safe, economical and environmentally acceptable electricity supply of the Land Baden-Wuerttemberg. The power station is of great significance to the region, both in terms of power supply and the economy. (orig.).

14520 (INIS-SU–231, pp. 36-39) **Ventilation and air ejection organizing from unserviced rooms at NPPs with WWER reactors.** Kochhetkov, O.A. (and others); Sayanin, N.P.; Tal'yanskij, E.D. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Peculiarities of ventilation and air ejection from unserviced rooms are considered from the view point of problems of radiation safety and proving the normal working conditions for personnel, as well as maximum decrease of radiation effects on human population and environment under operation of NPPs with the WWER-440, and WWER-1000 reactors. The principle separate ventilation of rooms in pure and contaminated areas is provided. The air from uncerviced rooms after corresponding decontamination through a duct 150-200 m high.

14521 (INIS-SU–231, pp. 54-57) **Hydrogen isotope production in the WWER-1000 reactor.** Popov, S.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Calculations of tririum and deuterium production in the WWER-1000 reactor coolant are carried out. To revel the effect of reactor different operating conditions (start-up, coming to full power, operation at rated power) on tritium concentration and to determine ways of tritium propagation along NPP area systematic measurements in water circuits of out. Calculations show that due to leaks in primary coolant circits.The main sources of tritium accumulation in the coolant are $^{10}\beta(n,2d)^{3}H$ and $^{6}Li(n,d)^{3}H$ reactions. Under operation at rated power tritium concentration attains 13 MBg/kg in the primary coolant circuit and 3 MBg/kg in water treatment system.

14522 (JAERI-M–90-209) **MELPROG-PWR/MOD1/V3 analysis of ACRR DF-2 experiment.** Matsumoto, Kiyoshi (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Shida, Wataru; Takigawa, Yoshio. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 32p. (In Japanese). Order Number DE91767888. Source: OSTI; NTIS (US Sales Only); INIS.

The MELPROG code is being developed at Sandia National Laboratories (SNL) for the U.S. Nuclear Regulatory Commission (NRC) as a part of the mechanistic models for severe accident progression designed to provide detailed, best-estimate, couples analyses of all the system in the course of the accident, in the Severe Fuel Damage and Source Term (SFD/ST) Program of the U.S.NRC. This report describes validation and assessment of the fuel rods behavior models of the CORE module in the MELPROG through the analysis of the severe fuel damage experiment DF-2. The CORE module is one of the modules in the MELPROG and is being developed to analyse core structure behavior. The version of the MELPROG used in the analysis is the MELPROG-PWR/MOD1/V3 which has been installed in Japan Atomic Energy Research Institute (JAERI). The DF-2 experiment is one of the Damaged Fuel and Relocation (DFR) Experiments performed in the Annular Core Research Reactor (ACRR) in the SNL under the U.S.NRC SFD/FPST program. The analytical results indicated that CORE module properly models fuel heatup by fission heat and metal-water reaction before zircaloy-4 fuel cladding melts. It was also indicated that there is some problem in the models treating fuel cladding behavior after zircaloy-4 in the cladding melts. In the sensitivity analysis, the calculated results were properly improved by use of the crucibilization effect model of the SEFDAN code developed in JAERI for fuel rod behavior when Zircaloy-4 in the cladding melts. (author).

14523 (KFK–4826) **CHF-KFK-3: A critical heat flux correlation for triangular arrays of rods with tight lattices.** Dalle Donne, M. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Nukleare Sicherheitsforschung. Feb 1991. 34p. Order Number DE91765027. Source: OSTI; NTIS (US Sales Only); INIS.

High converting PWR's (HCPWR or APWR) are based on fuel elements with rods placed in a tight lattice triangular array. The CHF correlation development previously at KfK for such geometry (CHF-KFK-2 correlation) has been tested against recently performed experiments. The comparison with the Siemens-KWU experiments with rod clusters with spacer grid and six integral spiral ribs supports has allowed to improve and extended the previous correlation. A new correlation, called CHF-KFK-3, which accounts for these improvements, is presented in the paper. (orig.).

14524 (NUREG/CR–5285) **Closeout of IE Bulletin 79-13: Cracking in feedwater system piping.** Foley, W.J. (Parameter, Inc., Elm Grove, WI (USA)); Dean, R.S.; Hennick, A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Operational Assessment; Parameter, Inc., Elm Grove, WI (USA). Mar 1991. 45p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (PARAMETER/IE–176). Source: OSTI; NTIS; INIS; GPO.

This report documents closeout of IE Bulletin 79-13 regarding cracks in the feedwater system piping of certain PWRs. Closeout is based on implementation and verification of six required actions by licensees and three required actions by designated applicants for operating licenses (DAOLs). Evaluations of licensee responses, NRC/Regional inspection reports, and NRC memoranda in accordance with specific criteria indicates that the bulletin is closed for all of the 54 PWRs required to respond, including 13 DAOLs. It is concluded that (1) actions required by the bulletin have been taken by the affected facilities, and (2) the concerns expressed in the bulletin were validated in that cracks were found and corrected at 18 of the 54 facilities.

2103 Power Reactors, Nonbreeding, Graphite Moderated

Refer also to citation(s) 14599, 14602

14525 (INIS-SU–231, pp. 118-121) **Use of the AFA and AFAS-I filter packets for studying gaseous effluents of the RBMK-1000 reactor under acid washing.** Petryanov, I.V. (and others); Borisov, I.B.; Ogorodnikov, B.I. Gosudarstvennyj Komitet

po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Analysis of NPP gaseous effluents during regular acid washing of the RBMK-1000 reactor primary coolant circuits is carried out. Sampling at radiation dose monitoring section was realized using a packet of analytical filters, consisting of series of the AFA-RMP and sorbing AFAS-I filters. Sample volume was varied from 1.44 to 12.04 m^3. The data obtained show that in gaseous effluents six radionuclides ^{24}Na, ^{131}I, ^{132}Te, ^{132}I, ^{133}I and ^{137}Cs are presrnt in appreciable amounts. Study of the above-mentioned nuclide content dependences on reactor coolant circuit washing operations shows that these dependences have different character for aerosol and gaseous fractions. Concentration of aerosol fraction slightly varies after coolant circuit washing, while concentration of iodine gaseous nuclides sharply increases with acid solution introduction into the circuit.

14526 (Juel–2411) **Determining the potential volume of industrial process steam to be generated in nuclear facilities.** Angewandte Systemanalyse. Jobsky, T. Forschungszentrum Juelich GmbH (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung; Technische Hochschule Aachen (Germany, F.R.). Nov 1990. 147p. (In German). Order Number DE91764962. Source: OSTI; NTIS (US Sales Only); INIS.

The present study serves to determine the market potential of nuclear energy for industrial process steam supply according to branches and sites in the Federal Republic of Germany (excluding the new East German Laender). On the nuclear plant side two HTR reference plants with different unit powers of 200 MWth (HTR-Modul) and 100 MWth are investigated. An essential result in analysing the nuclear market potential is the finding that the number of potential users and sites will triple if smaller unit sizes were introduced. This corresponds to an increase in nuclear plant potential from 28 units of 200 MWth each to 91 units of 100 MWth on the assumptions made in this study. A comparison of economic efficiency between fossil-fired power production plants and the HTR-Modul shows the competitiveness of nuclear process steam and electricity production in the base load range. A single-site evaluation for the centres of energy demand competes conceptually with a combined heat supply by nuclear long-distance energy. This integrated supply concept makes it possible to supply considerably more industrial companies with process steam while reducing the number of sites, since the heat requirements of smaller sites can also be covered by the integrated system. (orig.).

2104 Power Reactors, Nonbreeding, Otherwise Moderated or Unmoderated

Refer also to citation(s) 14196, 14214, 14569, 14594, 14637

14527 (BNWL-CC–655) **Investigation of the combined failure of a pressure tube and defected fuel rod in PRTR.** Freshley, M.D.; Wheeler, R.G.; Batch, J.M.; Hesson, G.M. Battelle Pacific Northwest Lab., Richland, WA (USA). 13 May 1966. 155p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009604. Source: OSTI; NTIS; GPO Dep.

On September 29, 1965, a pressure tube ruptured in the Fuel Element Rupture Test Facility (FERTF), of the Plutonium Recycle Test Reactor (PRTR). The incident released substantial amounts of fission products into the reactor core and containment vessel, and resulted in gross degradation of the heavy water moderator by light water from the FERTF. Damage to the reactor was slight. A technical review of the incident was instigated to determine major contributing factors to the incident because of the value of the data which were produced and the technical implications of operating oxide fuel at high specific powers. Such a review is reported here. The fuel testing program in the PRTR preceding the incident included an evaluation of the irradiation performance of vibrationally compacted mixed-oxide fuels operating at high specific powers. Nondefected and defected fuel element tests were being conducted in the FERTF at high specific powers with maximum fuel temperatures above the melting point. At the time of the incident, a fuel element with an intentionally defected UO_2-4 wt% PuO_2 fuel rod was being irradiated in the FERTF. After the incident, it was found that the defected rod had ruptured and had lost an appreciable amount of fuel material. Detailed post-examinations have been made of the fuel element, the pressure tube, and the thermal-hydraulic conditions which existed at the time of the incident. The results of these examinations are presented in this report along with an explanation of the events which are thought to be the most likely cause of the incident.

14528 (INIS-mf–12806, pp. 139-144) **The Canadian program on thorium fuel cycles in CANDU reactors.** Slater, J.B. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Continued development of thorium cycles for the CANDU reactor appears to offer advantages in both the short and long term. Their development will enhance confidence in the availability of nuclear fuel supplies at an acceptable cost, and the need for fissile breeding systems will be deferred for several decades. Conversely, development of thorium cycles is a necessary prelude to developing CANDU-LMFBR symbiotic systems optimized to exploit the potential of both systems. Finally, development of this cycle will significantly extend the technological lifetime of CANDU. This cycle will provide a degree of flexibility of response which will be needed to deal with the wide spectrum of possible energy futures.

14529 (INIS-mf–12807, pp. 10.1-10.7) **Ontario Hydro's nuclear program: Operation, safety and prospects.** Talbot, K.H. (Ontario Hydro, Pickering, ON (Canada). Pickering Generating Station). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Ontario Hydro has been utilizing nuclear fission for the production of electricity for 26 years. Presently the contribution of nuclear generation to Ontario's electrical energy supply is approaching 50%. The use of the CANDU Pressurized Heavy Water Reactor has proved extremely successful and future electricity demand/supply planning will include it as one of the main supply options. This paper describes the prominent features of Ontario Hydro's successful adoption of CANDU technology, highlighting the reasons for its safe, reliable, clean, and cost effective operation. The paper also outlines the strategies being examined in Ontario for the future energy supply/demand options.

14530 (INIS-mf–12807, pp. 10.18-10.21) **Radioactive component and fuel handling using remote/robotic equipment at Ontario Hydro's Pickering nuclear generating station.** Underhill, H.J. (Ontario Hydro, Pickering, ON (Canada). Pickering Generating Station). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Pickering NGS is comprised of eight 540 megawatt nuclear generating units. Each unit has on-power remote fuelling capability, which collectively handles about 25,000 fuel bundles per year. To accomplish daily on-power fuelling in extreme radiation fields, remote/robotic type equipment and systems have been designed and developed by Atomic Energy of Canada Ltd. to a reliable and sophisticated state. Capabilities of the equipment have been greatly extended beyond the original design of fuelling requirements to include reactor fuel channel abnormal recovery operations and fuel

channel inspection. Reactor structure inspection and maintenance needs have led to numerous cases of specially designed remote tooling and adaptation of some commercial robotic devices.

14531 (INIS-mf–12807, pp. 10.22-10.27) **The relationship between natural uranium and advanced fuel cycles in CANDU reactors.** Lane, A.D. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.); McDonnell, F.N.; Griffiths, J. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

CANDU is the most uranium-economic type of thermal power reactor, and is the only type used in Canada. CANDU reactors consume approximately 15% of Canadian uranium production and support a fuel service industry valued at ~$250 M/a. In addition to their once-through, natural-uranium fuel cycle, CANDU reactors are capable of operating with slightly-enriched uranium (SEU), uranium-plutonium and thorium cycles, more efficiently than other reactors. Only SEU is economically attractive in Canada now, but the other cycles are of interest to countries without indigenous fuel resources. A program is underway to establish the fuel technologies necessary for the use of SEU and the other fuel cycles in CANDU reactors.

14532 (INIS-mf–12807, pp. 11.8-11.15) **CANFLEX - an advanced bundle design for introducing slightly-enriched uranium into CANDU.** Hastings, I.J. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.); Boczar, P.G.; Lane, A.D. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

The CANDU reactor is performing well with the current once-through, natural uranium fuelling; more than 600,000 bundles have been irradiated commercially with a low defect rate. One component of the Atomic Energy of Canada Limited strategy to maintain and improve the competitive position of CANDU is the introduction of slightly-enriched uranium (SEU), less than 1.5 wt% U-235 in U. The CANFLEX (CANdu FLEXible) advanced bundle-design is a superior format for introducing SEU and other advanced fuel cycles into CANDU. The advanced bundle is a logical extension of existing technology, and contains 43 elements with two element sizes. The CANFLEX development and demonstration program comprises performance testing, design and specification, thermalhydraulic confirmation, safety analysis, reactor physics, and handling/endurance tests. An important component of the CANFLEX product is the data base and modelling capability generated during development, to support licensing. The goal is a bundle design available for a large-scale commercial demonstration by 1992/93.

14533 (INIS-mf–12807, pp. 8.1-8.6) **Design of CANDU fuel.** Sejnoha, R. (Atomic Energy of Canada Ltd., Sheridan Park, ON (Canada). CANDU Operations); Oldaker, I.E. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

The role of design, fuel manufacturing and reactor operation in achieving the outstanding performance record of CANDU reactor fuel is discussed. It is shown that design has contributed towards this record by producing reactor and fuel specifications with an adequate balance between fuel minimum strengths and maximum loads. Design requirements and design features of CANDU fuel, and expected future development are described.

14534 (INIS-mf–12807, pp. 8.16-8.25) **Structure of the CANDU fuel bundle.** Teed, D.E. (Canadian General Electric Co. Ltd., Peterborough, ON (Canada)); Tarasuk, W.R. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

GE Canada manufactures components for CANDU fuel bundles at its three plants in Ontario, i.e. UO_2 fuel pellets in Toronto, Zircaloy-4 tubing in Arnprior, and fuel bundles in Peterborough. This report details the Zircaloy-4 structural components that make up the CANDU fuel bundle. These components are tubes, bearing pads, spacers, plugs, and end supports. Component manufacture and the various manufacturing processes associated with the components are discussed. Careful attention to material and process control is mandatory to ensure a reproducible high integrity product.

14535 (INIS-mf–12807, pp. 8.26-8.34) **In-core fuel management in CANDU-PHW reactors.** Gold, M. (Ontario Hydro, Toronto, ON (Canada)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Fuel management plays a key role in both the design and subsequent operation of a CANDU reactor. Discussed in this paper are the fuel management design process (particularly its interaction with other aspects of the reactor design), the role of fuel management during reactor operation, and the fuel management implication of Ontario Hydro's proposed use of enriched uranium fuel.

14536 (INIS-mf–12807, pp. 8.35-8.40) **CANDU fuel performance.** Truant, P.T. (Ontario Hydro, Toronto, ON (Canada)); Floyd, M.R. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Ontario Hydro has more than 170 reactor-years experience in operating CANDU reactors. Fuel performance has been excellent with more than 70,000 channel fueling operations successfully completed and 99.9% of the more than 500,000 fuel bundles irradiated operating as designed. Fuel performance limits and fuel defects have had a negligible effect on station safety, reliability, the environment and cost. The actual incapability charged to fuel is less than 0.1% over the station's lifetimes, and more recently has been zero.

2105 Power Reactors, Breeding

Refer also to citation(s) 14572, 14638

14537 (CONF-910602–8) **Thermal striping of a rod: Thermoelastic solution for sinusoidal fluid temperature.** Feldman, E.E.; Chang, L.K.; Lee, M.J. Argonne National Lab., IL (USA). [1990]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. From American Society of Mechanical Engineers (ASME) pressure vessels and piping conference; San Diego, CA (USA); 23-27 Jun 1991. Order Number DE91007326. Source: OSTI; NTIS; INIS; GPO Dep.

A numerical solution is obtained for the one-dimensional temperature distribution in a rod which is assumed to be immersed in a fluid of sinusoidally-varying temperature. Readily available stress equations are combined with the thermal solution to perform a structural analysis in which all stresses are assumed to be within the elastic limit of the material. This leads to a parametric set of dimensionless curves which explain the interaction of the relevant parameters, such as the rod size and material properties, the frequency and amplitude of the fluid temperature oscillation, and the fluid thermal resistance at the surface of the rod. A hypothetical example is given in which the results are applied to thermal striping in the outlet plenum of a liquid metal reactor. 2 refs., 3 figs., 1 tab.

14538 (FEI–2019) **Experimental investigation into radionuclide transport inside primary circuit of the BN-350 and BR-10**

fast sodium cooled reactors. Bolgarin, V.I. (and others); Efimov, I.A.; Zhilkin, A.S. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1989. 44p. (In Russian). Order Number DE91624993. Source: OSTI; NTIS (US Sales Only); INIS.

Results of experimental investigations of contamination of working media of the BR-10 and BN-350 reactors by radioactive corrosion and fission products as well as by fuel are presented. Particular attention is paid to radionuclides contained in wall deposits of pipelines and equipment which determine the residual radioactivity of the primary circuit after reactor shut-down. 14 refs.; 13 figs.; 22 tabs.

14539 (INIS-mf–12807 P.19-P.21) **The European fast breeder reactor program.** Hulst, J. (CEA, 75 - Paris (France)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Fast breeder reactor technology has been developed in Europe for more than 30 years. Collaboration between European countries has played, since 1973, a major role, and important steps on the way to the industrial development of FBRs have been reached. Important efforts need to be made to reach competitiveness and prepare for commercial introduction of FBRs in Europe, but experience gained and progress made show that this objective is achievable in the mid-term. In this respect, EFRUG decided in 1987 on the study of a European Fast Reactor based on a common design. Engineering companies, supported by R and D organizations, are expected to complete conceptual and detailed design within 5 years, allowing a decision to build a plant in 1993.

14540 (INIS-SU–231, pp. 27-30) **Radiation safety during the BN-600 reactor operation at the Beloyarsk NPP.** Golikov, V.Ya.; Korenkov, I.P.; Pol'skij, O.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

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Data on the activity of technological fluids in the primary and secondary coolant circuits, dose rates of neutron and gamma radiations in main reactor compartments during the Beloyarsk Npp BN-600 reactor operation at rated power, as well as data on daily average effluents of inert radioactive gases and long-living and short-living aerosols into atmosphere are analysed. The conclusion is made that under reactor operation at rated power the personnel safety is ensured entirely. radioactive iodine in the effluents is not detected.

2106 Power Reactors, Auxiliary, Mobile, Package, and Transportable

Refer also to citation(s) 15974

14541 (INIS-mf–12807, pp. 11.16-11.22) **Small Canadian reactors for heat, electricity and steam.** Green, R.E. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Although nuclear reactors currently produce 15% of the world's electricity, this represents only 5% of the world's total energy consumption, since less than 30% of the world's primary energy is used to generate electricity. Another 30% of the world's energy consumption is used to supply low-grade heat, mainly to heat buildings. Other potential applications for nuclear energy are the generation of electricity for areas remote from electrical grids and oil or gas pipelines, and the production of high-grade steam. These applications represent opportunities for small nuclear reactors if certain technological and/or economic criteria can be met. The paper will describe new reactor concepts currently being developed by Atomic Energy of Canada Limited that we believe will meet these criteria, thereby providing an important contribution to the world's energy supply.

14542 (WHC-SA–1007) **A comparison between classical and substructuring finite-element stress analysis of a complex vacuum vessel shell.** Rezvani, M.A.; Ziada, H.H. Westinghouse Hanford Co., Richland, WA (USA). Jan 1991. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. (CONF-910602–18: American Society of Mechanical Engineers (ASME) pressure vessels and piping conference, San Diego, CA (USA), 23-27 Jun 1991). Order Number DE91010035. Source: OSTI; NTIS; INIS; GPO Dep.

In this study, the middle part of a vacuum vessel was considered for stress analysis. This section consisted of a cylindrical shell with flanges at the ends to be connected to the other parts of the vessel. Because of the nature of the design, many penetrations to the shell result in a complex structure. The shell was modeled and analyzed using a commercially available finite-element package. The package had substructuring capability that allowed the structure to be modeled and analyzed in sections and assembled at the end. For stress analysis, the structure was modeled and analyzed both as a unit and as a substructure. This paper compares stress results, analysis effort, and time for the two methods (structure as a unit and the structure as a substructure). Substructuring becomes advantageous when a finite-element model is very large or very complicated. Also, during the design process when intermediate analysis steps are required, application of substructuring will reduce the modeling time as well as computer central processing unit (CPU) time for the analysis. 6 figs., 6 refs., 1 tabs.

2107 Regulation and Licensing

Refer also to citation(s) 16030

14543 (INIS-mf–12807, pp. 9.1-9.5) **The nuclear fuel cycle and federal regulation, including future trends.** Measures, M.P. (Atomic Energy Control Board, Ottawa, ON (Canada)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

The radiation protection aspects of the Canadian Atomic Energy Control Regulations reflect to a large extent the recommendations of the International Commission on Radiological Protection. However, the Atomic Energy Control Board also applies its own extensive experience with the nuclear fuel cycle when formulating these Regulations. This paper discusses the extent to which the current Regulations and the proposed General Amendments to the Regulations reflect current ICRP philosophy and outlines the possible direction of future regulatory action.

14544 (NRC–5-INDEX-1) **Indexes to Nuclear Regulatory Commission issuances, January–March 1977: Index 1.** Nuclear Regulatory Commission, Washington, DC (USA); Department of Energy, Oak Ridge, TN (USA). Technical Information Center. [1977]. 72p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (NTISUB/C–142/401). Source: OSTI; NTIS; INIS; GPO.

Issuances of the Atomic Safety and Licensing Board (ASLB), the Atomic Safety and Licensing Appeal Board (ASLAP), and the regulatory issuances of the Commission (NRC) for the period January through March 1977 appear in Nuclear Regulatory Commission Issuances, 5 NRC No. 1, Pages 1–402, through 5 NRC No. 3, Pages 501–715. Digests and indexes for these issuances are presented in this document. These digests and indexes are intended to serve as a guide to the issuances. These information elements are displayed in one or more of five separate formats arranged as

follows: case name index, digests and headers, legal citation index, subject index, and facility index.

14545 (NRC–5-No.1) **Nuclear Regulatory Commission issuances, January 1977.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records. Jan 1977. 409p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (NTISUB/B–142-77/001). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), and the Atomic Safety and Licensing Boards (LPB).

14546 (NRC–5-No.2) **Nuclear Regulatory Commission issuances, February 1977.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records. Feb 1977. 105p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (NTISUB/B–142-77/002). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), and the Atomic Safety and Licensing Boards (LBP).

14547 (NRC–5-No.3) **Nuclear Regulatory Commission issuances, March 1977.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records. Mar 1977. 221p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (NTISUB/C–142-77/003). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), and the Atomic Safety and Licensing Boards (LPB).

14548 (NRC–6-No.3) **Nuclear Regulatory Commission issuances, September 1977.** Nuclear Regulatory Commission, Washington, DC (USA). Sep 1977. 81p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (NTISUB/C–142/009). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), and the Atomic Safety and Licensing Boards (LPB).

14549 (NRC–10-No.5) **Nuclear Regulatory Commission issuances, November 1979.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records. Nov 1979. 61p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (NTISUB/E–142/011). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specific period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors Denial (DD), and the Denial of Petition for Rulemaking.

14550 (NRC–11-Index-1) **Indexes to Nuclear Regulatory Commission issuances, January–March 1980.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records. Jan 1980. 56p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (PB–80-914/202-11-Index-1). Source: OSTI; NTIS; INIS; GPO.

Issuances of the Atomic Safety and Licensing Board (ASLB), the Atomic Safety and Licensing Appeal Boards (ALAB), regulatory issuances of the Commission (CLI), and the Directors Denial (DD), for the period January through March 1980 appear in Nuclear Regulatory Commission Issuances, 11 NRC No. 1, Pages 1–181, through 11 NRC No. 3, Pages 405–510. Digests and indexes for these issuances are presented in this document. These digests and indexes are intended to serve as a guide to the issuances. These information elements are displayed in one or more of five separate formats arranged as follows: case name index, digests and headers, legal citation index, subject index, and facility index.

14551 (NRC–11-No.3) **Nuclear Regulatory Commission issuances, March 1980.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records. Mar 1980. 112p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (PB–80-914202-11-No.3). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specific period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors Denial (DD), and the Denial of Petition for Rulemaking.

14552 (NRC–11-No.4) **Nuclear Regulatory Commission issuances, April 1980.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records. Apr 1980. 129p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (PB–80-914204-11-No.4). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specific period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors Denial (DD), and the Denial of Petition for Rulemaking.

14553 (NRC–11-No.6) **Nuclear Regulatory Commission issuances, February 1980.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records. Feb 1980. 228p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (PB–80-914202-11-No.6). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specific period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors Denial (DD), and the Denial of Petition for Rulemaking.

14554 (NRC–12-No.1R) **Nuclear Regulatory Commission issuances, July 1980.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records. Jul 1980. 144p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (PB–80-914207-12-No.1R). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specific period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors Denial (DD), and the Denial of Petition For Rulemaking.

14555 (NRCI–76/12) **Nuclear Regulatory Commission issuances, December 1976.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Rules and Records. Dec 1976. 62p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (NTISUB/B–142-76/012). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), and the Atomic Safety and Licensing Boards (LPB).

14556 (NRCI–76/Index-3) **Indexes to Nuclear Regulatory Commission Issuances, July–September 1976.** Nuclear Regulatory Commission, Washington, DC (USA); Energy Research and Development Administration, Oak Ridge, TN (USA). Technical Information Center. [1976]. 43p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (NTISUB/B–142-76/403). Source: OSTI; NTIS; INIS; GPO.

Issurances of the Atomic Safety and Licensing Board (ASLB), the Atomic Safety and Licensing Appeal Board (ASLAB), and regularly issuances of the Commission (NRC) for the period July through September 1976 appear in Nuclear Regulatory Commission Issuances, NRCI-76/7 through NRCI-76/9. Digests and indexes for these issuances are presented in this document. These digests and indexes are intended to serve as a guide to the issuances. These information elements are displayed in one or more of five separate formats arranged as follows: case name index, digest and headers, legal citation index, subject index, and facility index.

14557 (NUREG–0040-Vol.14-No.4) **Licensee contractor and vendor inspection status report: Quarterly report, October–December 1990.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Reactor Inspection and Safeguards. Feb 1991. 270p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

This periodical covers the results of inspections performed by the NRC's Vendor Inspection Branch that have been distributed to the inspected organizations during the period from October 1990 through December 1990.

14558 (NUREG–0304-Vol.15-No.4) **Regulatory and technical reports (Abstract Index Journal): Volume 15, No. 4: Annual compilation for 1990.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Mar 1991. 124p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

This journal includes all formal reports in the NUREG series prepared by the NRC staff and contractors; proceedings of conferences and workshops; as well as international agreement reports. The entries in this compilation are indexed for access by title and abstract, secondary report number, personal author, subject, NRC organization for staff and international agreements, contractor, international organization, and licensed facility.

14559 (NUREG–0540-Vol.13-No.1) **Title list of documents made publicly available, January 1–31, 1991: Volume 13, No. 1.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Mar 1991. 325p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

This monthly publication contains descriptions of the information received and generated by the US Nuclear Regulatory Commission (NRC). This information includes docketed material associated with civilian nuclear power plants and other uses of radioactive materials and nondocketed material received and generated by NRC pertinent to its role as a regulatory agency. This series of documents is indexed by a Personal Author Index, a Corporate Source Index, and a Report Number Index. The docketed information contained in the Title List includes the information formerly issued through the Department of Energy publication Power Reactor Docket Information, last published in January 1979.

14560 (NUREG–0750-Vol.21-No.2) **Nuclear Regulatory Commission issuances, February 1985: Volume 21, No. 2.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Technical Information and Document Control. Feb 1985. 201p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

14561 (NUREG–0750-Vol.32-Index2) **Indexes to Nuclear Regulatory Commission issuances, July–December 1990: Volume 32, Index 2.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Mar 1991. 66p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

Digests and indexes for issuances of the Commission (CLI), the Atomic Safety and Licensing Appeal Panel (ALAB), the Atomic Safety and Licensing Board Panel (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking are presented in this document. These digests and indexes are intended to serve as a guide to the issuances. These information elements are displayed in one or more of five separate formats arranged as follows: case name index, digests and headers legal citations index, subject index, and facility index.

14562 (NUREG–0750-Vol.33-No.1) **Nuclear Regulatory Commission issuances: Volume 33, No. 1.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Jan 1991. 68p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judges (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

14563 (NUREG–0940-Vol.9-No.4) **Enforcement actions: Significant actions resolved: Quarterly progress report, October–December 1990: Volume 9, No. 4.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Enforcement. Feb 1991. 383p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). Source: OSTI; NTIS; INIS; GPO.

This compilation summarizes significant enforcement actions that have been resolved during one quarterly period (October–December 1990) and includes copies of letters, Notices, and Orders sent by the Nuclear Regulatory Commission to licensees with respect to these enforcement actions. It is anticipated that the information in this publication will be widely disseminated to managers and employees engaged in activities licensed by the NRC, so that actions can be taken to improve safety by avoiding future violations similar to those described in this publication.

14564 (NUREG/CR–2000-Vol.10-No.1) **Licensee Event Report (LER) compilation for month of January 1991: Volume 10, No. 1.** Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data; Oak Ridge National Lab., TN (USA). Feb 1991. 89p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC05-84OR21400. (ORNL/NSIC–200-Vol.10-No.1). Source: OSTI; NTIS; INIS; GPO.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-0161, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 – Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System – Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule.

14565 (NUREG/CR–2000-Vol.10-No.2) **Licensee Event Report (LER) compilation for month of February 1991.** Nuclear Regulatory Commission, Washington, DC (USA). Office for Analysis and Evaluation of Operational Data; Oak Ridge National Lab., TN (USA). Mar 1991. 108p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC05-84OR21400. (ORNL/NSIC–200-Vol.10-No.2). Source: OSTI; NTIS; INIS; GPO.

This monthly report contains Licensee Event Report (LER) operational information that was processed into the LER data file of the Nuclear Safety Information Center (NSIC) during the one month period identified on the cover of the document. The LERs, from which this information is derived, are submitted to the Nuclear Regulatory Commission (NRC) by nuclear power plant licensees in accordance with federal regulations. Procedures for LER reporting for revisions to those events occurring prior to 1984 are described in NRC Regulatory Guide 1.16 and NUREG-0161, Instructions for Preparation of Data Entry Sheets for Licensee Event Reports. For those events occurring on and after January 1, 1984, LERs are being submitted in accordance with the revised rule contained in Title 10 Part 50.73 of the Code of Federal Regulations (10 CFR 50.73 – Licensee Event Report System) which was published in the Federal Register (Vol. 48, No. 144) on July 26, 1983. NUREG-1022, Licensee Event Report System – Description of Systems and Guidelines for Reporting, provides supporting guidance and information on the revised LER rule.

2108 Economics

Refer also to citation(s) 14519, 14528, 14531, 14535, 14620

14566 (INIS-mf–12806, pp. 34-35) **The nuclear ingredient in Canada's industrialization.** Donnelly, J. (Atomic Energy of

Canada Ltd., Ottawa, ON (Canada)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The energy scene in Canada has been confused by a changing industrial and economic pattern, a proliferation of energy options, a conflict of energy priorities, and possibly a media and anti-nuclear inspired perception that electricity is expensive and not a good substitute for oil. In spite of an economic down-turn, in 1982-83 five new CANDU reactors with a combined capacity of 3000 MW were completed in Canada. Opportunities exist for increased use of electricity both in households and in industry. The benefits of nuclear power have extended beyond a reliable and economic energy supply to research advances, job creation, and the overall industrial development of the country.

14567 (INIS-mf–12806, pp. 41-51) **Nuclear power development in Japan.** Toyota, M. (Tokyo Electric Power Co., Inc. (Japan)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Since the first light water reactor was commissioned in Japan in 1970, the emphasis in research and development has been on reducing costs, ensuring safety, and improving reliability. The capacity factor of Japanese LWRs has been improving steadily and availability should increase to 70 percent. Construction costs have been high, but efforts to promote standardization, rationalize design and shorten the construction period appear promising.

14568 (INIS-mf–12806, pp. 67-71) **Nuclear power generation in a newly industrialized society.** Chu, D.S.L. (Taiwan Power Co., Taipei (Taiwan)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Taiwan is considered one of the newly-industrialized countries of the Pacific Basin, having enjoyed rapid economic growth since the end of the 1940's. The power system has grown with the economy, having a capacity of 11,869 MW in 1983. Labour wages have increased, so in order to maintain its economic advantage, Taiwan must keep energy costs low. Nuclear power is becoming increasingly important, since fuel costs are only one third of those for coal. In 1983 there were four reactors in operation, with two more scheduled to come into commercial operation in 1984 and six units planned. By 2000 it is expected that nuclear will contribute 53 percent of Taiwan's expected 110,000 GWH of electricity generation.

14569 (INIS-mf–12806, pp. 145-148) **Tandem fuel cycle prospects in Korea.** Rim, C.S. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Korea has nine nuclear power plants under construction or in operation. Eight are PWRs, and two are CANDUs. The country has limited uranium resources. Spent fuel storage problems will occur from about 1992. However, mixed-oxide fuel containing plutonium and uranium recovered from used PWR fuel can be used in CANDU reactors. Such a PWR-CANDU tandem system is expected to result in uranium ore savings of about 40 percent relative to an all-PWR system on a once-through cycle. It is expected to become economic compared to once-through fuel cycles in the 1990s.

14570 (INIS-mf–12807 P.16-P.18) **Review of and prospects for the nuclear fuel cycle in China.** Liu Zunqi (Ministry of Nuclear Industry, Beijing, BJ (China)). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

The paper briefly introduces the establishment and development of the nuclear fuel cycle in China, including refining, conversion and enrichment of uranium, fabrication of fuel assemblies, reprocessing of spent fuels and solidification of liquid wastes with different levels of radioactivity. It also outlines the national policy, strategy and development programme for expanding and improving the cycle to support the programme of nuclear power generation by the year 2000. The nuclear fuel cycle is the basis of the nuclear power industry and nuclear science and technology as a whole. It includes uranium mining and milling, conversion and enrichment, fabrication of fuel elements, reprocessing of spent fuels, and treatment and disposal of radioactive wastes. The nuclear fuel cycle consists of a series of special industry categories characterized by the concentration of knowledge and techniques, by the adoption of specific and complicated processes and by the utilization of large quantities of special materials with high purity, radiation resistance, anticorrosiveness and perfect nuclear characteristics, as well as of equipment having high precision and reliability. All of these require a strong economic basis, large-scale developed industry, and a high level of science and technology. Therefore only a few countries have an integrated nuclear fuel cycle complex, although the application of nuclear energy and nuclear techniques is becoming world-wide.

14571 (INIS-mf–12807 P.9-P.15) **Nuclear fuel cycle activities of the International Atomic Energy Agency: Current status and future.** Mueller-Kahle, E. (International Atomic Energy Agency, Vienna (Austria)); Nechaev, A.; Onufriev, V.; Rojas, J.L.; Sokolov, F. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

The state-of-the-art in the world nuclear fuel cycle and the main areas of the IAEA programme in Nuclear Materials and Fuel Cycle Technology are reviewed with emphasis on expected changes and probable directions for international co-operation.

14572 (Risley-Trans–5972) **Future reactors and their fuel cycle.** Rastoin, J. (CEA (France)). AEA Technology, Risley (UK). 1990. 16p. Translated from French. (CONF-8910508–: ASPEA information session meeting on modern nuclear power stations, Zurich (Switzerland), 19 Oct 1989). Order Number DE91625116. Source: OSTI; NTIS (US Sales Only); INIS.

Translated from French.

Known world reserves of oil and natural gas may only last another 50 years and therefore nuclear energy will become more important in the future. Industrialised countries should also be encouraged to conserve their oil reserves to make better use of them and share them with less developed countries. France already produces 30% or more of its primary energy from uranium in the form of nuclear generated electricity. France has therefore accumulated considerable expertise in all aspects of the nuclear fuel cycle. Each stage of the fuel cycle, extraction, enrichment, fuel fabrication, fissile material utilisation, reprocessing and waste storage is discussed. The utilisation of fissile material is the most important stage and this is considered in more detail under headings: increase in burn-up, spectral shift, plutonium utilisation including recycling in pressurized water reactors and fast reactors and utilisation of reprocessed uranium. It is concluded that nuclear power for electricity production will be widely used throughout the world in the future. (UK).

22 NUCLEAR REACTOR TECHNOLOGY

14573 (INIS-SU–231) **Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.** Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i

Tekhnike. 1987 172p. (In Russian). (CONF-8412143--: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

Selected papers have been processed separately for inclusion in the data base.

2201 Theory and Calculation

Refer also to citation(s) 14605, 14629, 15760, 15779

14574 (ANL/CP-71385) **The DIF3D nodal kinetics capability in Hex-Z geometry: Formulation and preliminary tests.** Taiwo, T.A.; Khalil, H.S. Argonne National Lab., IL (USA). [1991]. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-910414--34: International topical meeting on advances in mathematics, computation and reactor physics, Pittsburgh, PA (USA), 28 Apr - 2 may 1991). Order Number DE91010796. Source: OSTI; NTIS; GPO Dep.

The development of a 3-D space- and energy-dependent neutron kinetics capability in Hexagonal-Z geometry is described. The code makes use of the nodal Hex-Z spatial differencing technique implemented in the ANL DIF3D code and, at present, the theta method for time integration. Results of numerical test problems are presented to verify the formulation of the kinetics code and to demonstrate its accuracy. The nodal differencing scheme is shown to yield more accurate transient results than does the standard (six triangle per hexagon) finite-difference scheme, which is considerably less efficient. Kinetics experiments conducted at the Savannah River Site have also been successfully analyzed using the nodal kinetics code. The time evolution and the asymptotic magnitudes of the flux tilts induced and measured in these experiments were predicted with good accuracy using the published cross section data and kinetics parameters. 11 refs., 6 figs., 3 tabs.

14575 (CONF-910603--7) **Analysis of neutron noise spectra using neural networks.** Korsah, K. (Oak Ridge National Lab., TN (USA)); Uhrig, R.E. Oak Ridge National Lab., TN (USA). [1991]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From Annual meeting of the American Nuclear Society (ANS); Orlando, FL (USA); 2-6 Jun 1991. Order Number DE91007676. Source: OSTI; NTIS; INIS; GPO Dep.

Neural network architectures based on the back-propagation paradigm have been developed to recognize the features, and detect resonance shifts in, power spectral density (PSD) data. Our goal is to advance the state of the art in the application of noise analysis techniques to monitor nuclear reactor internals. The initial objectives have been to use PSD data, acquired over a period of about 2 years by PSDREC (power spectral density recognition system), to develop neural networks that are able to differentiate between normal neutron power spectral density data and anomalous spectral data, and detect significant shifts in the positions of spectral resonances while reducing the effect of small shifts. Neural network systems referred to in this paper as spectral feature detectors (SFDs) and integral network filters have been developed to meet these objectives. The performance of the SFDs is the subject of this paper. 2 refs., 2 figs.

14576 (KAPL--4723) **Stochastic transport theory analysis of the Cf-252 Source Driven Noise Technique.** Sutton, T.M.; Doub, W.B. Knolls Atomic Power Lab., Schenectady, NY (USA). Feb 1991. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC12-76SN00052. (CONF-910414--31: International topical meeting on advances in mathematics, computation and reactor physics, Pittsburgh, PA (USA), 28 Apr - 2 may 1991). Order Number DE91010213. Source: OSTI; NTIS; INIS; GPO Dep.

This report presents a derivation of the relationship between the reactivity of a subcritical nuclear system and the quantity measured by the Cf-252 Source Driven Noise Technique. This experimental method uses the output signals of a fission chamber containing a Cf-252 source and those of two neutron detectors to form a particular ratio of four auto- and cross-power spectral densities. Several versions of the relationship between the measured ratio and the desired quantity – the system reactivity – have previously appeared in the literature. The result presented in this report does not agree with the most widely used previous version, nor does it agree with another proposed version. The origin of the differences are discussed. 10 refs.

2202 Components and Accessories

Refer also to citation(s) 14330, 14480, 14613, 14615, 14617, 14621, 14631, 14635, 14636, 14641, 14650, 15766, 15968

14577 (CONF-910535--1) **Investigation of neural network paradigms for the development of automatic noise diagnostic/reactor surveillance systems.** Korsah, K. (Oak Ridge National Lab., TN (USA)); Uhrig, R.E. Oak Ridge National Lab., TN (USA). [1991]. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG07-88ER12824 ;AC05-84OR21400. From 6. specialists meeting on reactor noise (SMORN); Gatlinburg, TN (USA); 19-24 May 1991. Order Number DE91009560. Source: OSTI; NTIS; INIS; GPO Dep.

The use of artificial intelligence (AI) techniques as an aid in the maintenance and operation of nuclear power plant systems has been recognized for the past several years, and several applications using expert systems technology currently exist. The authors investigated the backpropagation paradigm for the recognition of neutron noise power spectral density (PSD) signatures as a possible alternative to current methods based on statistical techniques. The goal is to advance the state of the art in the application of noise analysis techniques to monitor nuclear reactor internals. Continuous surveillance of reactor systems for structural degradation can be quite cost-effective because (1) the loss of mechanical integrity of the reactor internal components can be detected at an early stage before severe damage occurs, (2) unnecessary periodic maintenance can be avoided, (3) plant downtime can be reduced to a minimum, (4) a high level of plant safety can be maintained, and (5) it can be used to help justify the extension of a plant's operating license. The initial objectives were to use neutron noise PSD data from a pressurized water reactor, acquired over a period of ~2 years by the Oak Ridge National Laboratory (ORNL) Power Spectral Density RECognition (PSDREC) system to develop networks that can (1) differentiate between normal neutron spectral data and anomalous spectral data (e.g., malfunctioning instrumentation); and (2) detect significant shifts in the positions of spectral resonances while reducing the effect of small, random shifts (in neutron noise analysis, shifts in the resonance(s) present in a neutron PSD spectrum are the primary means for diagnosing degradation of reactor internals). 11 refs, 8 figs.

14578 (CONF-9103142--1-Vugraphs) **Check valves aging assessment.** Haynes, H.D. Oak Ridge National Lab., TN (USA). [1991]. 25p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC05-84OR21400. From 1991 Nuclear Plant Aging Research (NPAR) review group meeting; Rockville, MD (USA); 26-28 Mar 1991. Order Number DE91009629. Source: OSTI; NTIS; INIS; GPO Dep.

In support of the NRC Nuclear Plant Aging Research (NPAR) program, the Oak Ridge National Laboratory (ORNL) has carried out an assessment of several check value diagnostic monitoring methods, in particular, those based on measurements of acoustic emission, ultrasonics, and magnetic flux. The evaluations have focussed on the capabilities of each method to provide information useful in determining check valve aging and service wear effects, check valve failures, and undesirable operating modes. This paper describes the benefits and limitations associated with each method and includes recent laboratory and field test data, including data obtained from the vendors who recently participated in a comprehensive series of tests directed by a nuclear industry users group. In addition, as part of the ORNL Advanced Diagnostic Engineering Research and Development Center (ADEC), two novel nonintrusive monitoring methods were developed that provide several unique capabilities. These methods, based on external ac- an dc-magnetic monitoring are also described. None of the examined methods could, by themselves, monitor both the instantaneous position and motion of check valve internals and valve leakage; however, the combination of acoustic emission monitoring with one of the other methods provides the means to determine vital check valve operational information.

14579 (NUREG/CR–5619) **The impact of thermal aging on the flammability of electric cables.** Nowlen, S.P. (Sandia National Labs., Albuquerque, NM (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Sandia National Labs., Albuquerque, NM (USA). Mar 1991. 29p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC04-76DP00789. (SAND–90-2121). Source: OSTI; NTIS; INIS; GPO.

An investigation of the impact of thermal aging on the flammability of two common types of nuclear grade electrical cables has been performed. Four large-scale flammability tests were performed with each of the two cable types tested in both an unaged (i.e., new off the reel) and a thermally aged (artificially aged) condition. In all cases, the fire was observed to consume virtually all of the combustible cable jacket and insulation material present. However, for both cable types tested, the thermal aging process caused a decrease in the cable flammability as demonstrated by decreases in the rate of fire growth, peak fire intensity, total heat released and near fire temperatures. This result is consistent with past cable aging studies because it has been observed that the thermal aging process will drive off certain of the more volatile constituents of a polymeric material. Presumably, when these aged materials are subjected to a fire, the evolution of volatile combustible gases is reduced as compared to the unaged materials, and hence, flammability is reduced. The results of these tests indicate that, at least for the two cable types tested, the evaluation of cable flammability using unaged cable samples will remain a conservative indicator of cable flammability in a thermally aged condition. 6 refs., 18 figs., 3 tabs.

14580 (VTT-TIED–1184) **Systems behaviour and operational aspects of safety, research programme in 1990-1994.** Mattila, L. (Valtion Teknillinen Tutkimuskeskus, Otaniemi (Finland). Ydinvoimatekniikan Lab.); Vanttola, T. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Nov 1990. 64p. (In Finnish). Order Number DE91624951. Source: OSTI; NTIS (US Sales Only); INIS.

Studies in the field of safe operational margins of nuclear fuel and reactor core concentrate on fuel high burn-up behaviour, VVER fuel experiments, and reactor core behaviour in complex reactivity transients such as 3-D phenomena and ATWS events. Assessment of complex transient and accident situations provides up-to-date methods to evaluate the whole spectrum of transients and accidents relevant for licensing, plant-specific PSA and accident management. PACTEL is a new facility (scaled 1:305) for the Loviisa reactors for thermal hydraulic studies. Advanced computer codes from the US Nuclear Regulatory Commission's severe accident research program are implemented, modified as needed and applied to level-2 PSAs and improvement of accident management procedures. Fire simulation methods are tested using data from experiments in the German HDR facility. A nuclear plant analyzer for efficient safety analyses is being developed using the new APROS process simulation environment. New technology in nuclear power plant automation is particularly relevant for future plants but new technology is also applied at the present plants, particularly in case of life extension. Distributed digital automation systems will be assessed and validated. Computerized operator support systems are studied in cooperation with the OECD Halden Project. PRA/PSA methods are increasingly useful in management of nuclear power plant safety and performance. Prototype of a comprehensive plant safety information system is developed by combining living PSA, plant status monitoring and safety indicators into a kind of 'dynamic PSA'. The use of PSA methods during new plant design is also studied.

14581 (VTT-TUTK–708) **Evaluation of catastrophic failure risk in pressure vessels: Results of pressure vessel test with a large vessel (HC2-test).** Keinaenen, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio); Rintamaa, R.; Oeberg, T.; Sarkimo, M.; Talja, H.; Saarenheimo, A. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Sep 1990. 63p. Order Number DE91624952. Source: OSTI; NTIS (US Sales Only); INIS.

Within the Nordic countries a four-year research programme in the area of elastic-plastic fracture mechanics was initiated in 1985. Seven laboratories from Denmark, Finland, Norway and Sweden are participating in the programme. The main technical objective of the programme is to clarify how catastrophic fracture can be prevented in pressure vessels and piping by using the leak-before-break concept. The major experimental effort of the programme is destructive pressurization of a large size pressure vessel up to rupture. The vessel has dimensions similar to a nuclear reactor pressure vessel and it has been in operation for 20 years in a Finnish oil refinery plant. The materials characterization of the vessel has been partially carried out within an extensive Nordic round-robin programme. Two pressure tests have been carried out. In both tests an artificial sharp axial surface flaw was made on the inner wall of the vessel. The experimental details of the last test including repair welding of the vessel, flaw prepration, instrumentation and material characterization are described in this report. The fracture behaviour as well as experimental results are reported. The failure pressure is compared to estimates of the analytical pre-test calculations.

14582 (WSRC-MS–91-026) **WANTO 32: Proceedings of the 32nd Weapons Agencies Nondestructive Testing Organization meeting: Summary of meeting and technical presentations.** Majzlik, E.J. Jr. (comp.). Westinghouse Savannah River Co., Aiken, SC (USA). Feb 1991. 147p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. (CONF-9011174–: 32. meeting of the Weapons Agencies Nondestructive Testing Organization (WANTO), Aiken, SC (USA), 27-29 Nov 1990). Order Number DE91009334. Source: OSTI; NTIS; INIS; GPO Dep.

The Thirty-Second Weapons Agencies Nondestructive Testing Organization (WANTO) meeting was held at the Savannah River Site (SRS) on November 27–29, 1990. The meeting was hosted by Edward J. Majzlik, Jr., Savannah River Laboratory, Westinghouse Savannah River Company (WSRC). The Chairman of the WANTO Steering Committee is L.E. (Larry) Bryant, Los Alamos National Laboratory. This report is the sole proceedings of the meeting and includes the agenda, attendance, steering committee report, interim reports and technical presentation summaries. This report is the first to present the meeting proceedings in an unclassified form. The reader should contact individual authors directly for any additional information desired. The meeting was organized to provide coverage of a wide variety of NDE subjects relevant to the Department of Energy (DOE) Nuclear Weapons Complex (NWC). Approximately 60 technical experts and managers representing 11 DOE weapons agencies and 3 DOE offices attended. A total of 56 technical presentations and 3 special NDE workshops were included in the agenda along with two tours of the SRS Reactor Mock-up Facility. Invited presentations included five speakers who reported on the DOE sponsored conference Concurrent Engineering and the NDE Role held at Sandia National Laboratory, Albuquerque, New Mexico, October 30-November 1, 1990 and X-ray Film Retention and Disposal presented by Orville R. Pratt, DOE/AL-Martin Marietta. The WANTO Steering Committee report for the Thirty-Second Meeting immediately follows this section. The meeting Agenda and Attendance are presented in Appendices A and B, respectively. Technical presentation summaries and abstracts are presented in Appendix C. For cases in which a summary was not provided, a telephone number is offered for direct contact with the author/presenter. Interim Activity Reports are compiled in Appendix D. Special Workshop reports are presented in Appendix E. (JF)

2203 Fuel Elements

14583 (ECN-RX–90-031) **CER-MET SPHERE-PAC fuel potential.** Linde, A. van der. Netherlands Energy Research Foundation, Petten (Netherlands). Jun 1990. 30p. (CONF-9002178–: OECD enlarged halden group meeting on fuel performance experiments analysis, Bolkesjoe (Norway), 11-16 Feb 1990). Order Number DE91625930. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted for publication.

During operation of the fuel rods in an LWR core the low thermal conductivity of oxide fuel causes high temperatures in the fuel column. This imposes restrictions on the permissible power increases of the fuel rods during in-reactor operation. In a joint KEMA-ECN-GKN programme the applicability of a 3-fraction mixture of large MOX spheres with medium and small natural UO_2 spheres in an 88 percent smear density sphere-pac columns of LWR fuel rods

has been shown. A 3-fraction CER-MET sphere-pac fuel column of large UO_2 or MOX spheres with medium and small spheres of a metal alloy, has a much higher thermal conductivity than pure oxide fuel. Sooner or later uranium becomes scarcer and plutonium from reprocessing plants has to be used in LWR fuel. Then, for CER-MET sphere-pac fuel only 1 fraction has to be fabricated from the plutonium of the reprocessing plants. Moreover, thanks to the low operation temperatures in the CER-MET sphere-pac fuel column the restrictions on power increases become less stringent and the stored heat in the core is lower than in pure oxide cores. The major material aspects of this new CER-MET sphere-pac fuel are presented here. (author). 19 refs.; 7 tabs.

14584 (VTT-TIED–1141) **Nuclear fuel structure and fuel behaviour.** Hansson, L. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Metallilaboratorio); Kosonen, A.-M.; Planman, T.; Vitikainen, E. Valtion Teknillinen Tutkimuskeskus. Espoo (Finland). Jun 1990. 36p. (In Finnish). Order Number DE91624958. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of the research has been to produce information on structural properties of nuclear fuel and their effects on the fuel behaviour. The research subjects were new fuel fabrication and quality control methods, the effects of as-fabricated pellets properties on the behaviour of fuel rods, behaviour of cladding materials and irradiated cladding and structural materials. At the Technical Research Centre of Finland (VTT) the nuclear fuel structure and behaviour programme has produced data which have been utilized in procurement, behavioural analysis and surveillance of the fuel used in the Finnish nuclear power stations. In addition to our own research, data on fuel behaviour have been received by participating in the international cooperation projects, such as OECD/Halden, Studsvik-Ramp-programmes, IAEA/BEFAST II and VVER-fuel research projects. The volume of the research work financed by the Finnish Ministry of Trade and Industry (KTM) and the Technical Research Centre of Finland in the years 1987-1989 has been about 8 man years. The report is the summary report of the research work conducted in the KTM-financed nuclear fuel structure and fuel behaviour programme in the years 1987-1989.

2204 Control Systems

Refer also to citation(s) 14646, 15028

14585 (BNL-NUREG–45748) **Aging mechanisms in the Westinghouse PWR [Pressurized Water Reactor] Control Rod Drive system.** Gunther, W.; Sullivan, K. Brookhaven National Lab., Upton, NY (USA). [1991]. 5p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-910602–10: American Society of Mechanical Engineers (ASME) pressure vessels and piping conference, San Diego, CA (USA), 23-27 Jun 1991). Order Number DE91008110. Source: OSTI; NTIS; INIS; GPO Dep.

An aging assessment of the Westinghouse Pressurized Water Reactor (PWR) Control Rod System (CRD) has been completed as part of the US NRC's Nuclear Plant Aging Research, (NPAR) Program. This study examined the design, construction, maintenance, and operation of the system to determine its potential for degradation as the plant ages. Selected results from this study are presented in this paper. The operating experience data were evaluated to identify the predominant failure modes, causes, and effects. From our evaluation of the data, coupled with an assessment of the materials of construction and the operating environment, we conclude that the Westinghouse CRD system is subject to degradation which, if unchecked, could affect its safety function as a plant ages. Ways to detect and mitigate the effects of aging are included in this paper. The current maintenance for the control rod drive system at fifteen Westinghouse PWRs was obtained through a survey conducted in cooperation with EPRI and NUMARC. The results of the survey indicate that some plants have modified the system, replaced components, or expanded preventive maintenance. Several of these activities have effectively addressed the aging issue. 2 refs., 2 figs., 2 tabs.

14586 (EGG-M–91009) **A proven knowledge-based approach to prioritizing process information.** Corsberg, D.R. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1991]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-9105157–1: 6. annual Goddard conference on space applications of artificial intelligence, Greenbelt, MD (USA), 13-15 May 1991). Order Number DE91010098. Source: OSTI; NTIS; GPO Dep.

Many space-related processes are highly complex system subject to sudden, major transients. In any complex process control system, a critical aspect is rapid analysis of the changing process information. During a disturbance, this task can overwhelm humans as well as computers. Humans deal with this by applying heuristics in determining significant information. This paper describes a simple, knowledge-based approach to prioritizing information. The approach models those heuristics that humans would use in similar circumstances. The approach described in the paper has received two patents and has been implemented in the Alarm Filtering System (AFS) at the Idaho National Engineering Laboratory (INEL). AFS was first developed for application in a nuclear reactor control room. It has since been used in chemical processing applications, where it has had a significant impact on control room environments.

14587 (IAE–4749-15) **On the use of fuzzy logics in the operator support system of an experimental facility.** Mozhaev, A.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR. Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 29p. (In Russian). Order Number DE91624960. Source: OSTI; NTIS (US Sales Only); INIS.

Problems of consrtuction of the computerized operator support system of the experimental device are considered on the basis of the imitation decision-making model which uses the fuzzy logic apparatus for a formal description of the decision-making process. 22 refs.; 4 figs.; 2 tabs.

14588 (JAERI-M–90-207) **Development of accident diagnosis and prediction system for research reactor: A pilot system of early fault detection expert system to reduce scram frequency.** Yokobayashi, Masao (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Matsumoto, Kiyoshi; Murayama, Yoji; Kaminaga, Masanori; Kohsaka, Atsuo. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 33p. (In Japanese). Order Number DE91767863. Source: OSTI; NTIS (US Sales Only); INIS.

A pilot system of early fault detection expert system has been developed. The early fault detection expert system is one of subsystems in the accident diagnosis and prediction system for the research reactor JRR-3 in JAERI. Functions of the pilot system are to detect deviations of process parameters from the steady state in the early stage of the transient and, if possible, to provide procedures to operators to avoid scram actuation. The reactor accident diagnosis system, DISKET, which had been developed in JAERI, was applied for developing the pilot system by extending functions as follows. (1) A frame structure has been introduced to a part of the knowledge base of DISKET in order to infer efficiently. (2) Numerical equation has been introduced to rule representation in order to calculate numerical value for rules. The pilot system was tested against some simulated transients to validate the effectiveness of the extension mentioned above as well as the performance of the system. This report describes development of the pilot system and the results of the test. (author).

14589 (NUREG/CR–5555) **Aging assessment of the Westinghouse PWR Control Rod Drive System.** Gunther, W. (Brookhaven National Lab., Upton, NY (USA)); Sullivan, K. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Brookhaven National Lab., Upton, NY (USA). Mar 1991. 189p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC02-76CH00016. (BNL-NUREG–52232). Source: OSTI; NTIS; INIS; GPO.

A study of the effects of aging on the Westinghouse Control Rod Drive (CRD) System was performed as part of the Nuclear Plant Aging Research (NPAR) Program. The objectives of the NPAR Program are to provide a technical basis for identifying and evaluating the degradation caused by age in nuclear power plant systems, structures, and components. The information from NPAR studies will be used to assess the impact of aging on plant safety and to

develop effective mitigating actions. The operating experience data were evaluated to identify predominant failure modes, causes, and effects. For this study, the CRD system boundary includes the power and logic cabinets associated with the manual control of rod movement, and the control rod mechanism itself. The aging-related degradation of the interconnecting cables and connectors and the rod position indicating system also were considered. The evaluation of the data, when coupled with an assessment of the materials of construction and the operating environment, leads to the conclusion that the Westinghouse CRD system is subject to degradation from aging which, if unchecked, could affect its intended safety function and performance as a plant ages. The number of CRD system failures which have resulted in a reactor trip (challenge to the safety system) warrants continued attention. Ways to detect and mitigate the effects of aging are included in this report. The current maintenance practices for the control rod drive system for fifteen Westinghouse plants were obtained through an industry survey. The results of the survey indicate that some plants have modified the system, replaced components, or expanded preventive maintenance. 33 refs., 35 figs., 18 tabs.

14590 (WSRC-MS–90-192) **Reliability evaluation of the Savannah River reactor leak detection system.** Daugherty, W.L. (Westinghouse Savannah River Co., Aiken, SC (USA)); Sindelar, R.L.; Wallace, I.T. Westinghouse Savannah River Co., Aiken, SC (USA). [1991]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. (CONF-910602–7: American Society of Mechanical Engineers (ASME) pressure vessels and piping conference, San Diego, CA (USA), 23-27 Jun 1991). Order Number DE91007231. Source: OSTI; NTIS; INIS; GPO Dep.

The Savannah River Reactors have been in operation since the mid-1950's. The primary degradation mode for the primary coolant loop piping is intergranular stress corrosion cracking. The leak-before-break (LBB) capability of the primary system piping has been demonstrated as part of an overall structural integrity evaluation. One element of the LBB analyses is a reliability evaluation of the leak detection system. The most sensitive element of the leak detection system is the airborne tritium monitors. The presence of small amounts of tritium in the heavy water coolant provide the basis for a very sensitive system of leak detection. The reliability of the tritium monitors to properly identify a crack leaking at a rate of either 50 or 300 lb/day (0.004 or 0.023 gpm, respectively) has been characterized. These leak rates correspond to action points for which specific operator actions are required. High reliability has been demonstrated using standard fault tree techniques. The probability of not detecting a leak within an assumed mission time of 24 hours is estimated to be approximately 5×10^{-5} per demand. This result is obtained for both leak rates considered. The methodology and assumptions used to obtain this result are described in this paper. 3 refs., 1 fig., 1 tab.

2205 Environmental Aspects

Refer also to citation(s) 14326, 14327, 14638, 15330

14591 (INIS-mf–12806, pp. 200-216) **A review of seismicity, siting and design criteria in Canada and Pacific Basin countries.** Charlwood, R.G. (Klohn Leonoff Ltd., Vancouver, BC (Canada)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

This paper provides a brief review of the earthquake history of the Pacific Basin region. Three different types of plate boundary fault system occurs at different parts of the Pacific Rim. This accounts for the relative levels of seismicity in the Pacific Rim countries. Canada, Western USA, Mexico, Colombia, Ecuador, Peru, Chile, Japan, China, Taiwan, Indonesia and New Zealand are relatively active areas, while Korea, Thailand, Malaysia, Singapore and Australia are less active. A brief review of the trends in development of seismic design criteria for 'critical facilities' in Canada is given. This indicates an effort to provide consistent levels of seismic design for a full range of facilities in addition to nuclear power plants. The rigorous methods developed for nuclear power plants may be of benefit in the development of design codes for other facilities.

14592 (INIS-mf–12806, pp. 217-220) **Panel: Experts from non-supplier countries and regions.** Subki, I.R. (National Atomic Energy Agency, Jakarta (Indonesia)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Because of the high seismicity of the West Java area, the MPR research reactor is being designed to withstand a major earthquake. The dynamic model used in the design of the reactor is described.

14593 (INIS-mf–12806, pp. 222-232) **Seismic criteria and practice: Recent developments in the United States.** Hadjian, A.H. (Bechtel Power Corp., San Francisco, CA (USA)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

During the previous decade interest in seismic design considerations has not abated in the United States. This paper reviews the major developments in recent years as advanced in practice, research and regulations. This paper emphasizes the major developments in recent years as advanced in practice, research and regulations. All aspects of seismic design, from the definition of ground motion to the qualification of equipment and components, from deterministic design procedures to probabilistic evaluation of the safety of nuclear power plants, have been undergoing change. These developments are reviewed under the main objectives of safety/regulations, design improvements and standardization.

14594 (INIS-mf–12806, pp. 233-242) **Canadian seismic design criteria and methods for CANDU-PHW nuclear power plants.** Duff, C.G. Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The Canadian seismic design criteria and methods for seismically qualifying CANDU-PHW nuclear power plants are unique in some respects, especially in terms of design conservatism, preoperational inspection and avoidance of any need to cater explicitly for an operating basis earthquake. By designing essential structures and systems to at least the earthquake requirements of the National Building Code of Canada and all areas important to safety to the low-probability DBE, using conservative criteria, CANDU nuclear power plants are capable of safely surviving any earthquake they are likely to experience during their operating lifetime.

14595 (INIS-mf–12806, pp. 243-254) **Recent developments in seismic design criteria and practice in Japan.** Watabe, M. (Building Research Inst., Tokyo (Japan)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The author reviews the philosophy and guidelines for aseismic design of nuclear reactor facilities in Japan, as well as methods for modeling the seismic effects of design basis earthquakes.

14596 (INIS-mf–12806, pp. 256-277) **Aseismic design and experience of nuclear reactor facilities in Japan.** Kato, M. (Japan Atomic Power Co., Tokyo (Japan)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Aseismic design in Japan is based on such measurable design parameters as soil properties, soil damping, component damping,

restoring force characteristics, and ultimate strength using tests, experiments, or conservative assumptions. Aseismic designs based on such safety considerations are further qualified through careful examination by administrative offices and technical advisory committees. Reactor buildings and similar structures are further tested in the Pre-Service Inspection. Records are kept of seismic forces experienced by reactor buildings. No nuclear power plants in Japan have ever experienced earthquakes the magnitude of the design basis earthquake. MITI has constructed a super-large vibration table and a large-scale aseismic proving test on major nuclear power plant components has been carried out. Power companies are carrying out further research of their own. It remains to establish that design procedures are as safe as possible without being overcautious.

14597 (INIS-SU–231, pp. 41-47) **Realization of sanitary requirements concerning standardization of rare radioactive gas-effluents at NPPs.** Doroshenko, G.G.; Panchenko, S.V.; Chudajkin, O.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

The paper is aimed at determination of ways for practical realization of main sanitary requirements concerning environment and population protection under NPP operation. The idea of the requirements is reduced to not increasing permissible limits for radiation doses, minimum irradiation of population and decrease of unjustified irradiation of personnel. The given problem may be fully solved only in case of studying real chacteristics of operating reactors, taking into account statistic nature of effluents of inert radioactive gases (IRG). Methods of developing a system of working and reference standards of IRG effluents at NPPs are suggested. The considered approach may be realized in practice as the All-Union state on branch standards.

14598 (INIS-SU–231, pp. 73-75) **Ecological problems of nuclear power industry development.** Diboens, I.K.; Revina, S.K.; Burtsev, C.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Problems of nuclear power industry development are considered of NPP site selection. During site selection a series of factors should be taken into account: availability of water resources, cost and possible land use, the land ecology, effect of meteorological factors on radiation situation in the region, possibility of radioactive waste underground disposal, geological and seismic conditions etc. Requirements for designs and also the order of their approach by GOSCOMGIDROMET are presented.

14599 (INIS-SU–231, pp. 47-50) **To the technique of radioactive iodine determination near a NPP.** Ogorodnikov, B.I.; Borisov, N.B.; Skitovich, V.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

To study the laws of radioactive iodine in environment and to estimate its biological danger the information on forms of iodine pressure in the earth atmosphere is nessesary. It is revealed that a great amount of iodine radioisotopes is in hardly-sorbed gaseous form, that is not collected by usual aerosol filters. About 60-70-% of ^{131}I and ^{133} is in gaseous state. Iodine concentration in aerosol form is not over $2.7x10^{-5}$ Bq/m^3.

14600 (INIS-SU–231, pp. 75-78) **Assessment of environmental radiation safety.** Belitskij, A.S. (and others); Markelova, V.F.; Orlova, E.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

To forecast radiation hazard, caused by leak of liquid wastes from containments, experimental investigations on NPPs with different type reactors have been carried out. Chemical and radiation characteristics of liquid wastes and capability of rocks underlying the site to sorb waste nuclides, were studied. Presented experimental data and prediction calculations show that under natural hydrogeological conditions radionuclide migration in underground wastes is detailed. This restricts radionuclide contamination. For siting liquid waste storages it is recommended to select regions with favourable hydrogeological conditions.

14601 (INIS-SU–231, pp. 39-41) **Characteristics of gaseous-aerosol effluents of NPP with WWER-440 reactors.** Vorob'ev, A.M. (and others); Gavrilin, Yu.I.; Selivanova, P.E. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Results of studying the content and isotope composition of radionuclides in air ejected from compartment of the Rovno-1 and Rovno-2 reactors through the NPP ventilation tube are presented. Specific activity of short-living β-active aerosols in air of ventilation systems and ejected through the tube didn't exceed $7.4x10^2$ Bq/m^3, and those for long-living radionuclides is defined mainly by ^{131}I, ^{88}Rb, ^{138}Cs, and those of long-living ones by ^{51}Cr, ^{60}Co, ^{58}Co, ^{110m}Ag. Normalized of tritium oxide into atmosphere constituted $7.4x10^6$ Bq/MW (el)xyear. A conclusion is made that gaseous-aerosol effluents of a NPP with the WWER-440 reactors are much less than the standard values. They don't cause sufficient radionuclide concentration of environment.

14602 (INIS-SU–231, pp. 107-109) **Use of the method of multilayer filters for monitoring the dispersivity of radioactive aerosols of NPPs.** Ogorodnikov, B.N.; Ckitovich, V.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Using the AFA multilayer analytical filters the sizes of radioactive aerosols, produced during operation of a NPP with the RBMK-1000 reactor, are determined. For comparison the disppersivity of natural radioactive aerosols near Leningrad is measured. The volume of samples when sampling from NPP ventilation system constituded 50-100 m^3 of air at the linear filteration rate through the 3 cm ^{3} in-area filter being 2,0 m/s. In some cases particle radii differ from the mean ones almost by 2 fold. It is connected with transients in NPP operation. The form of particle size distribution curves has no significant peculiarities for different nuclides. 2 refs.; 2 tab.

2206 Research, Test, and Experimental Reactors

Refer also to citation(s) 14505, 14506, 14507, 14508, 14509, 14510, 14511, 14512, 14513, 14514, 14515, 14587, 14588, 14592, 14629, 15975

14603 (IFE/KR/E–90/001) **The decommissioning of a small nuclear reactor: Model study - February 1990.** Neset, K.; Christensen, G.C.; Lundby, J.E.: Roenneberg, G.A. Institutt for Energiteknikk, Kjeller (Norway). Feb 1990. 54p. (In Norwegian). Order Number DE91624996. Source: OSTI; NTIS (US Sales Only); INIS.

The JEEP II reactor at Kjeller, Norway has been used as a model for a study of the decommissioning of a small research reactor. A radiological survey is given and a plan for volume reducing, packaging, certifying, classifying and shipping of the radioactive waste is described. 23 refs., 4 figs.

14604 (INIS-SU–231, pp. 113-116) **Determination of radioactive aerosol disperse composition in research reactor technological systems.** Budyka, A.K.; Fedorov, G.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Disperse cvomposition of radioactive aerosols, formied during operation of the IRT and WWR-M reaearch water cooled and moderated reactors, is atudied using filter packet technique. The samples were selected from the IRT reactor special ventilation system the above core qud experimental channel header, and from the WWR-M reactor above- and below-core chambers. Search foe distribution parameters (active median radius r/50 and standard geometrical deviation) was carried out by means of the special program for the BESM-6 computer data obtained show that short-living aerosols have the best size. It is concluded that sizes of radioactive aerosols formined during coolant mechanical transfer are larger than sizes of aerosols formed in horizontal experimental channels.

14605 (INIS-SU–236/A, pp. 3-14) **Experimental and calculational study of small sample reactivity in critical assemblies with different heterogeneous structure.** Bednyakov, S.M. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.); Dulin, V.A.; Heinzelmann, B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 154p. (In Russian). In *Nuclear constants: Scientific-technical collection.* Order Number DE91003078. Source: OSTI; NTIS (US Sales Only); INIS.

The quality of introducing heterogeneous and bilinear resonance corrections to calculations of central reactivity coefficients of standard materials possessing well-known cross sections is investigated using the critical assemblies -BN-600 type reactor models - with different degree of the fuel heterogeneity. For this purpose necessary measurements are performed. Heterogeneous and bilinear resonance corrections are obtained by two methods: on the base of integral-transport approximation and a more correct approximation, developed by Heinzelmann B., accounting in particular, the dependence of neutron flux and validity on the direction of their scattering. It is shown that the reactivity method is a reliable instrument of testing the accuracy of calculating the balance of fissions and captures in fissionable elements. 10 refs.; 1 fig.; 6 tabs.

2207 Plutonium and Isotope Production Reactors

Refer also to citation(s) 14324, 14327, 14344, 14345, 14347, 14582, 14590, 14624, 14625, 14626, 14627, 14628, 14630, 14631, 14632, 14633, 14647, 14648, 14649, 14651, 14652, 14653, 14950

14606 (CONF-910535–2) **Plant monitoring and signal validation at HFIR.** Mullens, J.A. Oak Ridge National Lab., TN (USA). [1991]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 6. specialists meeting on reactor noise (SMORN); Gatlinburg, TN (USA); 19-24 May 1991. Order Number DE91009637. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes a monitoring system for the Oak Ridge National Laboratory's (ORNL'S) High Flux Isotope Reactor (HFIR). HFIR is an 85 MW pressurized water reactor designed to produce isotopes and intense neutron beams. The monitoring system is described with respect to plant signals and computer system; monitoring overview; data acquisition, logging and network distribution; signal validation; status displays; reactor condition monitoring; reactor operator aids. Future work will include the addition of more plant signals, more signal validation and diagnostic capabilities, improved status display, integration of the system with the RELAP plant simulation and graphical interface, improved operator aids, and an alarm filtering system. 8 refs., 7 figs. (MB)

14607 (DUN–6594-Del.) **Douglas United Nuclear monthly report, January 1970.** Douglas United Nuclear, Inc., Richland, WA (USA). 18 Feb 1970. 55p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009220. Source: OSTI; NTIS; GPO Dep.

The declassified January, 1970, monthly progress report of activities at the Douglas United Nuclear, Inc., facilities in Richland, Washington, contains information on operation of Hanford special production reactors, fuel and target fabrication, technical activities in support of these operations, irradiation services, and administrative considerations. A feature report is included on precision extrusion of uranium and zircaloy. (MB)

14608 (ECN-RX–90-057) **Present state of neutron metrology in the high flux reactor.** Polle, A.N. (Netherlands Energy Research Foundation, Petten (Netherlands)). Netherlands Energy Research Foundation, Petten (Netherlands). Aug 1990. 16p. (CONF-900814–: 7. ASTM-EURATOM symposium on reactor dosimetry, Strasbourg (France), 27-31 Aug 1990). Order Number DE91626020. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted for publication.

An exchange of information on the practical aspects of the neutron metrology work can serve to establish improved metrology procedures. A summary is given of applied hardware, software and quality control procedures at the Netherlands Energy Research Foundation (ECN) to arrive at detailed neutron spectrum information and characteristic spectrum parameters derived from activation monitors. Most of the neutron metrology work is related to the material and fuel testing programs carried out in the High Flux Reactor at Petten. This material testing reactor contains in the core lattice 19 experiment positions. The metrology concerns also the work for the reactor vessel surveillance program and the work for the neutron characterization of beam facilities. The energy distribution of the neutron fluence correlates with the material neutron damage due to irradiation. For ECN-laboratory neutron metrology results are the basis upon which quality and reliability of the neutron fluence and damage characterization parameters are assured. The metrology procedures have been improving for many years. The authors present a summary of their present laboratory practice. (author). 10 refs.; 12 figs.; 1 tab.

14609 (HW–66454) **Fast startup—KE reactor, August 5, 1960.** Nelson, S.L. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 25 Aug 1960. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009425. Source: OSTI; NTIS; GPO Dep.

KE reactor was scrammed at 9:51 a.m. on August 5, 1960, by a low flow trip on KER Loop No. 1 caused by KER pump difficulties. The condition causing the scram was corrected following which a "hot" startup was made. During the rise to level, the rate of power increase allowed by Process Standards was considerably exceeded. A power level of between 2000 and 2400 mw was attained momentarily at which at time a panellit (low trip) scram shut the reactor down. Although power level itself was not excessive and no fuel damage was sustained, the potential for serious difficulty requires that the situation be carefully reviewed.

14610 (WHC-SA–1107) **Remote mechanical "C" line: A simulation-based training program.** Gardner, P.R.; Nuttall, K.R.

Westinghouse Hanford Co., Richland, WA (USA). Feb 1991. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. (CONF-9104135–3: 9. symposium on the training of nuclear facility personnel, Denver, CO (USA), 14-18 Apr 1991). Order Number DE91009422. Source: OSTI; NTIS; INIS; GPO Dep.

Westinghouse Hanford Company is developing a desktop simulation-based training program on the operation of the Remote Mechanical "C" Line process in Plutonium Finishing Plant on the Hanford Site, Richland, Washington. Simulations display and continually update current values of system parameters on computer graphics of Remote Mechanical "C" Line equipment. Instructors can select programmed faults to test student responses to off-normal events. Students are given computer-based tutorials on the function, processes, operation, and error conditions associated with individual components. Phase 1 of the course was completed in December 1990. Because of the slowly responding nature of the actual process, the Remote Mechanical "C" course can retain many of the capabilities of practice and testing in a simulated work environment while avoiding the cost of a full scale simulator and the exposure and waste developed by practice runs of the Remote Mechanical "C" Line. Development costs for Phase 1, which provide some 4 to 8 hours of training, were about $400,000. This is primarily a tooling-up cost: construction of course templates, mastering certain language interfaces, etc. Costs for the remainder of the course are also estimated at $400,000, but will provide an additional 18 to 20 hours of training. Proposals being written for the development of similar training packages for other process lines at the Hanford Site take advantage of computer routines already developed.

2208 Propulsion Reactors

14611 (EGG-NE–9087) **Gas core reactors for direct nuclear propulsion.** Schnitzler, B.G. EG and G Idaho, Inc., Idaho Falls, ID (USA). Jun 1990. 120p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. Order Number DE91010050. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Gas core nuclear reactors offer the potential for achieving very high specific impulse in a space propulsion engine. The absence of any solid material in the core allows operation with propellant exhaust temperatures in excess of 10,000 K. Specific impulses above 19,600 m/s (2000 seconds) can be achieved with hydrogen at these conditions. An EG & G Exploratory Research and Development Program (ERDP) was initiated at Idaho National Engineering Laboratory with the objectives of developing gas core reactor analysis capability and performing a preliminary performance characterization of the gas core direct nuclear propulsion engines. This report summarizes the analytical methods development and summarizes the results of the preliminary gas core characterization efforts. 18 refs., 6 figs., 20 tabs.

14612 (EGG-NERD–8585) **Fission fragment rocket scientific feasibility assessment: Final report.** Schnitzler, B.G.; Jones, J.L.; Chapline, G.F. EG and G Idaho, Inc., Idaho Falls, ID (USA). Jun 1989. 71p. Sponsored by USDOE, Washington, DC (USA); Lawrence Livermore National Lab., CA (USA); National Aeronautics and Space Administration, Washington, DC (USA). DOE Contract AC07-76ID01570 ;W-7405-ENG-48. CONTRACT NASA DPR W0-8857. Order Number DE91010076. Source: OSTI; NTIS (US Sales Only); INIS; GPO Dep.

A new reactor concept which has the potential of enabling extremely energetic and ambitious space propulsion missions into near interstellar space is described. Fission fragments are directly utilized as the propellant by guiding them out of a very low density core using magnetic fields. The very high fission fragment velocities correspond to specific impulses of about ten million m/s. Configurations capable of utilizing about 30% of the fission fragment kinetic energy yield specific impulses of about three million m/s. Results of preliminary scientific feasibility assessments focused on reactor physics, thermal management, and fission fragment extraction are reported. Comparisons of engine performance potential and requirements for Alpha Centauri and TAU (thousand astronomical units) missions are presented. 11 refs., 19 figs., 21 tabs.

2209 Reactor Safety

Refer also to citation(s) 14262, 14263, 14311, 14330, 14344, 14345, 14347, 14499, 14557, 14582, 14593, 14594, 14595, 14596, 15384, 15792, 15803

14613 (BNL-NUREG–44785) **Seismic component fragility data base for IPEEE.** Bandyopadhyay, K.; Hofmayer, C. Brookhaven National Lab., Upton, NY (USA). [1990]. 5p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9010330–1: 18. water reactor safety information meeting, Washington, DC (USA), 22-24 Oct 1990). Order Number DE91009448. Source: OSTI; NTIS; INIS; GPO Dep.

Seismic probabilistic risk assessment or a seismic margin study will require a reliable data base of seismic fragility of various equipment classes. Brookhaven National Laboratory (BNL) has selected a group of equipment and generically evaluated the seismic fragility of each equipment class by use of existing test data. This paper briefly discusses the evaluation methodology and the fragility results. The fragility analysis results when used in the Individual Plant Examination for External Events (IPEEE) Program for nuclear power plants are expected to provide insights into seismic vulnerabilities of equipment for earthquakes beyond the design basis. 3 refs., 1 fig., 1 tab.

14614 (BNL-NUREG–45736) **The effects of aging in component cooling water systems and the implications for life extension.** Lofaro, R. (Brookhaven National Lab., Upton, NY (USA)); Taylor, J.; Aggarwal, S. Brookhaven National Lab., Upton, NY (USA). [1991]. 6p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-910602–9: American Society of Mechanical Engineers (ASME) pressure vessels and piping conference, San Diego, CA (USA), 23-27 Jun 1991). Order Number DE91008109. Source: OSTI; NTIS; INIS; GPO Dep.

To help assess the effects of aging on safety and reliability, an aging and life extension analysis of component cooling water (CCW) systems in pressurized water reactors (PWRs) has been performed as part of the Nuclear Plant Aging Research (NPAR) program. The NPAR program is sponsored by the NRC Office of Research to provide a technical basis for understanding and managing the effects of aging degradation in nuclear plant applications. The objectives of the two phase CCW system analysis are to characterize the effects of aging, and identify effective methods of detecting and mitigating aging degradation. The effects of aging in CCW systems were characterized by collecting and analyzing failure data from various national databases. The dominant failure causes and mechanisms were identified along with the components most frequently failed. Time-dependent component failure rates were calculated and used to evaluate the effect of aging on system unavailability in later years. Inspection, surveillance, monitoring, and maintenance practices currently in use were compiled from plant and industry sources. These practices were correlated with various aging mechanisms and generic listings were developed for two of the most commonly failed CCW components. 2 refs., 6 figs., 4 tabs.

14615 (BNL-NUREG–45799) **Dependent failure analysis of NPP data bases.** Cooper, S.E. (Science Applications International Corp., San Diego, CA (USA)); Lofgren, E.V.; Samanta, P.K.; Wong, See-Meng. Brookhaven National Lab., Upton, NY (USA). [1990]. 22p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9010185–25: 18. water reactor safety information meeting, Gaithersburg, MD (USA), 22-24 Oct 1990). Order Number DE91009440. Source: OSTI; NTIS; INIS; GPO Dep.

A technical approach for analyzing plant-specific data bases for vulnerabilities to dependent failures has been developed and applied. Since the main purpose of this work, to aid in the formulation of defenses to dependent failures, is different than that for other dependent failure analyses, the approach of this analysis is also critically different. For instance, component failures have been defined to include all types of component function loss (e.g., catastrophic, degraded, incipient). Also, the determination of component

failure dependencies has been based upon identical failure mechanisms rather than failure modes. Consequently, in the context of this study, both the definition of component failure and a categorization scheme for component failure mechanisms are used to identify clusters of component failures which are termed common failure mechanism (CFM) events. Motor-operated valves (MOVs) in two nuclear power plant data bases have been analyzed with this approach. The analysis results include seven different failure mechanism categories; identified potential CFM events; and assessment of the risk-significance of the potential CFM events using existing probabilistic risk assessments (PRAs); and postulated defenses to the identified potential CFM events. 2 refs., 3 figs., 5 tabs.

14616 (BNL-NUREG–45855) **Analysis of crack initiation and growth in the high level vibration test at Tadotsu.** Kassir, M.K.; Hofmayer, C.H.; Bandyopadhyay, K.K. Brookhaven National Lab., Upton, NY (USA). [1991]. 4p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC02-76CH00016. Order Number DE91009481. Source: OSTI; NTIS; INIS; GPO Dep.

A High Level Vibration Test (HLVT) Program was carried out recently on the seismic table at the Tadotsu Engineering Laboratory of Nuclear Power Engineering Center (NUPEC) in Japan. The objective of the study being performed at Brookhaven National Laboratory is to use the HLVT data to assess the accuracy and usefulness of existing methods for predicting crack initiation and growth under complex, large amplitude loading. The work to be performed as part of this effort involves: (1) analysis of the stress/strain distribution in the vicinity of the crack, including the potential for residual stresses due to the weld repair; (2) analysis of the number of load cycles required for crack initiation, including estimates of the impact of the weld repair on the crack initiation behavior; (3) analysis of crack advance as a function of applied loading (classic fatigue versus cyclic tearing) taking into account the variable amplitude loading and the possible influence of the repair; and (4) material property testing to supplement the work performed as part of the HLVT, providing the materials data necessary to perform the analysis efforts. A summary of research progress for FY 1990 is presented. 2 refs.

14617 (CONF-910602–1) **Aging management of safety-related concrete structures in nuclear power plants.** Naus, D.J. (Oak Ridge National Lab., TN (USA)); Oland, C.B.; Arndt, E.G. Oak Ridge National Lab., TN (USA). [1990]. 17p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC05-84OR21400. From American Society of Mechanical Engineers (ASME) pressure vessels and piping conference; San Diego, CA (USA): 23-27 Jun 1991. Order Number DE91001635. Source: OSTI; NTIS; INIS; GPO Dep.

The Structural Aging Program has the overall objective of providing the US Nuclear Regulatory Commission with an improved basis for evaluating nuclear power plants for continued service. In meeting this objective, a materials property data base is being developed as well as an aging assessment methodology for concrete structures in nuclear power plants. Furthermore, studies are well under way to review and assess inservice inspection techniques for concrete structures and to develop a methodology which can be used for performing current as well as reliability-based future conditions assessments of these structures. 16 refs., 2 tabs.

14618 (CONF-910602–13) **A probabilistic approach to the evaluation of the PTS issue.** Cheverton, R.D.; Selby, D.L. Oak Ridge National Lab., TN (USA). [1991]. 28p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC05-84OR21400. From American Society of Mechanical Engineers (ASME) pressure vessels and piping conference; San Diego, CA (USA); 23-27 Jun 1991. Order Number DE91009125. Source: OSTI; NTIS; INIS; GPO Dep.

An integrated probabilistic approach for the evaluation of the pressurized-thermal-shock (PTS) issue was developed at the Oak Ridge National Laboratory (ORNL) at the request of the Nuclear Regulatory Commission (NRC). The purpose was to provide a method for identifying dominant plant design and operating features, evaluating possible remedial measures and the validity of the NRC PTS screening criteria, and to provide an additional tool for estimating vessel life expectancy. The approach was to be integrated in the sense that it would include the postulation of transients; estimates of their frequencies of occurrence; systems analyses to obtain the corresponding primary-system pressure, down-comer coolant temperature, and fluid-film heat-transfer coefficient adjacent to the vessel wall; and a probabilistic fracture-mechanics analysis, using the latter data as input. A summation of the products of frequency of transient and conditional probability of failure for all postulated transients provides an estimate of frequency of vessel failure. In the process of developing the integrated pressurized-thermal-shock (IPTS) methodology, three specific plant analyses were conducted. The results indicate that the NRC screening criteria may not be appropriate for all US pressurized water reactor (PWR) plants; that is, for some PWRs, the calculated mean frequency of vessel failure corresponding to the screening criteria may be greater than the maximum permissible value in Regulatory Guide 1.154. A recent view of the ORNL IPTS study, which was completed in 1985, indicates that there are a number of areas in which the methodology can and should be updated, but it is not clear whether the update will increase or decrease the calculated probabilities. 31 refs., 2 tabs.

14619 (CONF-910602–14) **Potential impact of enhanced fracture-toughness data on fracture mechanics assessment of PWR vessel integrity for pressurized thermal shock.** Dickson, T.L.; Theiss, T.J. Oak Ridge National Lab., TN (USA). [1991]. 9p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC05-84OR21400. From American Society of Mechanical Engineers (ASME) pressure vessels and piping conference; San Diego, CA (USA); 23-27 Jun 1991. Order Number DE91009554. Source: OSTI; NTIS; INIS; GPO Dep.

The Heavy Section Steel Technology (HSST) Program is involved with the generation of enhanced fracture-initiation toughness and fracture-arrest toughness data of prototypic nuclear reactor vessel steels. These two sets of data are enhanced because they have distinguishing characteristics that could potentially impact PWR pressure vessel integrity assessments for the pressurized-thermal shock (PTS) loading condition which is a major plant-life extension issue to be confronted in the 1990's. A series of large-scale fracture-mechanics experiments have produced crack-arrest (K_{Ia}) data with the distinguishing characteristic that the values are considerably above 220 MPA $\cdot \sqrt{m}$. The implicit limit of the ASME Code and the limit used in the Integrated Pressurized Thermal Shock (IPTS) studies. Currently, the HSST Program is planning experiments to verify and quantify for A533B steel the distinguishing characteristic of elevated the distinguishing characteristic of elevated initiation-fracture toughness for shallow flaws which has been observed for other steels. The results of the analyses indicated that application of the enhanced K_{Ia} data does reduce the conditional probability of failure P(F|E); however, it does not appear to have the potential to significantly impact the results of PTS analyses. The application of enhanced fracture-initiation-toughness data for shallow flaws also reduces P(F|E), and does appear to have a potential for significantly affecting the results of PTS analyses. 19 refs., 11 figs., 1 tab.

14620 (CONF-910603–2) **Evaluation of corrective action data for reportable events at commercial nuclear power plants.** Mays, G.T. Oak Ridge National Lab., TN (USA). [1991]. 6p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC05-84OR21400. From Annual meeting of the American Nuclear Society (ANS); Orlando, FL (USA); 2-6 Jun 1991. Order Number DE91007275. Source: OSTI; NTIS; INIS; GPO Dep.

805The Nuclear Regulatory Commission (NRC) approved the adoption of cause codes for reportable events as a new performance indicator (PI) in March 1989. Corrective action data associated with the causes of events were to be compiled also. The corrective action data was considered as supplemental information but not identified formally as a performance indicator. In support of NRC, the Nuclear Operations Analysis Center (NOAC) at the Oak Ridge National Laboratory (ORNL) has been routinely evaluating licensee event reports (LERs) for cause code and corrective action data since 1989. The compilation of corrective action data by NOAC represents the first systematic and comprehensive compilation of this type data. The thrust of analyzing the corrective

action data was to identify areas where licensees allocated resources to solve problems and prevent the recurrence of personnel errors and equipment failures. The predominant areas of corrective action reported by licensees are to be evaluated by NRC to compare with NRC programs designed to improve plant performance. The set of corrective action codes used to correlate with individual cause codes and included in the analyses were: training, procedural modification, corrective discipline, management change, design modification, equipment replacement/adjustment, other, and unknown. 1 fig.

14621 (CONF-9103142–2-Summ.) **Summary of nuclear plant aging research at Oak Ridge National Laboratory.** Eissenberg, D.M. Oak Ridge National Lab., TN (USA). [1991]. 35p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC05-84OR21400. From 1991 Nuclear Plant Aging Research (NPAR) review group meeting; Rockville, MD (USA); 26-28 Mar 1991. Order Number DE91009557. Source: OSTI; NTIS; INIS; GPO Dep.

Oak Ridge National Laboratory (ORNL) has been a major contributor to the Nuclear Regulatory Commission (NRC) Nuclear Plant Aging Research Program since its inception. The research at ORNL has consisted primarily of the preparation of comprehensive aging assessments and other studies of safety related and other components and systems. The components and systems have been identified and prioritized based on risk considerations, as well as by operating experience. In each case, ORNL has been preparing a Phase 1 assessment which summarizes design features, operating conditions, and stressors which lead to degradation and failure; identified parameters which could be used to detect, trend and differentiate the degradations; and proposed potential inspection, surveillance, and monitoring methods which could be applied to the parameters. Where appropriate, Phase 2 assessments have been prepared, which verify and recommend inspection, surveillance and monitoring methods based on vendor information, laboratory and field tests, and in-situ inspections and tests. Finally, Phase 3 assessments are prepared which provide recommendations regarding implementing the inspection, surveillance and monitoring methods, and provide recommendations regarding criteria to be applied. Other activities include providing assistance to NRC/Nuclear Regulatory Research and regional offices as requested, and participation in ASME and IEEE codes and standards.

14622 (CONF-9104135–) **Proceedings of the ninth symposium on the training of nuclear facility personel.** Oak Ridge National Lab., TN (USA). Apr 1991. 623p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 9. symposium on the training of nuclear facility personnel; Denver, CO (USA); 14-18 Apr 1991. Order Number DE91010496. Source: OSTI; NTIS; INIS; GPO Dep.

This document provides reports presented on training of nuclear facility personnel. The papers were presented in the following categories: engineering technical staff; specialty training; customer perspective/plant side; human factors/soft science; maintenance; simulator centered training; hands-on training devices; management training; and reduced O&M costs through training. Individual papers have been cataloged separately. (FI)

14623 (DOE/ID–10298) **Licensing design basis source term update for the Evolutionary Advanced Light Water Reactor: Advanced Reactor Severe Accident Program.** Leaver, D.E. (TENERA, L.P., Bethesda, MD (USA)); Denning, R.S.; Hobbins, R.R.; Metcalf, J.E.; Osetek, D.J.; Pasedag, W.F.; Ritzman, R.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). Sep 1990. 68p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. (MISC–90132). Order Number DE91010061. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this report is to document the technical basis for a licensing source term update for the Evolutionary Advanced Light Water Reactor (ALWR) which will make the source term more physically realistic. While TID [Technical Information Document] 14844 and related regulatory guidance have served the industry well, much has been learned about source term over the last 30 years, and the ALWR Requirements Document provides an opportunity to incorporate this experience by updating the licensing source term. Further, the source term update will provide an improved basis for evolutionary ALWR accident mitigation design. Results of this work indicate that the fission product release magnitude to containment is slightly less than TID 14844 for noble gas, iodine, and semi and low volatiles, but somewhat higher for cesium and tellurium. Release timing is delayed by one hour or more after the accident initiation. The chemical form of iodine is largely aerosol with significantly less organic iodine compared to regulatory guidance which specifies mostly elemental and a relatively large fraction of organic. Containment spray aerosol removal rate was determined to be significantly higher than specified in regulatory guidance. Finally, BWR suppression pool decontamination factor was determined to be less effective than allowed by regulatory guidance early in the accident (due to the delayed release noted above) and more effective than that allowed by regulatory guidance later in the accident. It is recognized by the ALWR program that the source term update could be taken further in the direction of a physically-based source term. 47 refs., 4 figs., 11 tabs.

14624 (DPST–67-285) **Subcooled burnout correlation for annuli.** Knoebel, D.H. Savannah River Lab., Aiken, SC (USA). 14 Aug 1967. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-76SR00001 ;AC09-89SR18035. Order Number DE91009998. Source: OSTI; NTIS; GPO Dep.

A large effort has been made to improve the (SRL) Savannah River Laboratory burnout correlation developed in 1964. This correlation has a standard deviation of 9.1% and a maximum deviation of 23.5%. Some efforts were made in the direction of improving the correlation of the existing data; however, this proved to be infeasible because of experimental uncertainties in the data. Therefore a program was begun to obtain better experimental burnout data on which an improved burnout correlation could be based. The initial correlation of the recent data is presented in this memorandum. This correlation was used in specifying operating safety limits for the mixed-lattice operation. 2 figs., 2 tabs.

14625 (DPST–83-718-Rev.1) **SRP reactor safety evolution: Revision 1.** Rankin, D.B. Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab. 15 May 1984. 32p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-76SR00001 ;AC09-89SR18035. Order Number DE91009309. Source: OSTI; NTIS; INIS; GPO Dep.

The Savannah River Plant reactors have operated for over 100 reactor years without an incident of significant consequence to on or off-site personnel. The reactor safety posture incorporates a conservative, failure-tolerant design; extensive administrative controls carried out through detailed operating and emergency written procedures; and multiple engineered safety systems backed by comprehensive safety analyses, adapting through the years as operating experience, changes in reactor operational modes, equipment modernization, and experience in the nuclear power industry suggested. Independent technical reviews and audits as well as a strong organizational structure also contribute to the defense-in-depth safety posture. A complete review of safety history would discuss all of the above contributors and the interplay of roles. This report, however, is limited to evolution of the engineered safety features and some of the supporting analyses. The discussion of safety history is divided into finite periods of operating history for preservation of historical perspective and ease of understanding by the reader. Programs in progress are also included. The accident at Three Mile Island was assessed for its safety implications to SRP operation. Resulting recommendations and their current status are discussed separately at the end of the report. 16 refs., 3 figs.

14626 (DPST–86-802) **Reactors PMT backlog.** Olson, H.P. Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab. 19 Dec 1986. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035 ;AC09-76SR00001. Order Number DE91009312. Source: OSTI; NTIS; INIS; GPO Dep.

The overall backlog of action items within the Reactors Priority Maintenance Tracking Systems (PMT) is similar to that resulting from Reactor Incident Reports. At least 1000 open action items are being tracked (excluding procedure revisions); the exact number is not obvious because some items are being tracked in more than one tracking document. About 20 to 25% of the incomplete items

are directly related to reactor safety. About 70% of these were initiated within the last two years. A few of the remaining 30% date back to the 1977-1980 time frame. The tracking systems that are in place serve particular needs but they are unconnected and do not provide a means to understand and manage the overall Reactors PMT backlog. Shortcomings are summarized. Several initiatives are in progress or planned by Reactors PMT to facilitate improved tracking of backlog items with computer software systems. Under consideration is the Integrated Living Schedule (ILS) approach to prioritize work items and schedule resources to manage the backlog in the most effective way. ILS systems are being used effectively by a number of nuclear power utilities. 6 refs., 6 figs., 1 tab.

14627 (EGG-EAST–9382) **Scaling analysis for a Savannah River reactor scaled model integral system.** Boucher, T.J.; Larson, T.K.; McCreery, G.E.; Anderson, J.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). Nov 1990. 142p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. Order Number DE91010070. Source: OSTI; NTIS; INIS; GPO Dep.

801The Savannah River Laboratory has requested that the Idaho National Engineering Laboratory perform an analysis to help define, examine, and assess potential concepts for the design of a scaled integral hydraulics test facility representative of the current Savannah River Plant reactor design. In this report the thermal-hydraulic phenomena of importance (based on the knowledge and experience of the authors and the results of the joint INEL/TPG/SRL phenomena identification and ranking effort) to reactor safety during the design basis loss-of-coolant accident were examined and identified. Established scaling methodologies were used to develop potential concepts for integral hydraulic testing facilities. Analysis is conducted to examine the scaling of various phenomena in each of the selected concepts. Results generally support that a one-fourth (1/4) linear scale visual facility capable of operating at pressures up to 350 kPa (51 psia) and temperatures up to 330 K (134°F) will scale most hydraulic phenomena reasonably well. However, additional research will be necessary to determine the most appropriate method of simulating several of the reactor components, since the scaling methodology allows for several approaches which may only be assessed via appropriate research. 34 refs., 20 figs., 14 tabs.

14628 (EGG-M–90056) **Advanced Test Reactor safety/risk improvements from the PRA.** Atkinson, S.A. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-900917–38: American Nuclear Society (ANS) topical meeting on the safety, status and future of non-commercial reactors and irradiation facilities, Boise, ID (USA), 30 Sep - 3 oct 1990). Order Number DE91010068. Source: OSTI; NTIS; INIS; GPO Dep.

The Level 1 probabilistic risk assessment (PRA) for the Advanced Test Reactor (ATR), continuing external events analyses, and the Level 2 PRA analyses have provided safety and risk insights and have identified beneficial safety and risk improvements for the ATR facility and its continuing safe operation. The safety and risk improvements consist of ATR system modifications or additions, control system upgrades in conjunction with the planned replacement of the reactor process and experiment control systems, improvements in training and emergency procedures, and the development of new symptom-based emergency and accident management procedures and related simulator upgrades. These safety insights and improvements do not imply an inadequate level of safety, only that improvements are desirable. 2 refs., 2 figs., 1 tab.

14629 (EGG-M–90354) **RELAP5 kinetics model development for the Advanced Test Reactor.** Judd, J.L.; Terry, W.K. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1991]. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-910414–27: International topical meeting on advances in mathematics, computation and reactor physics, Pittsburgh, PA (USA), 28 Apr - 2 may 1991). Order Number DE91010067. Source: OSTI; NTIS; INIS; GPO Dep.

A point-kinetics model of the Advanced Test Reactor has been developed for the RELAP5 code. Reactivity feedback parameters were calculated by a three-dimensional analysis with the PDQ neutron diffusion code. Analyses of several hypothetical reactivity insertion events by the new model and two earlier models are discussed.

14630 (EGG-M–91043) **In-pipe viewing system for reactor coolant measurement.** Evans, R.P.; Flitton, M.K.A. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1991]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-910598–3: 37. Instrument Society of America international instrumentation symposium, San Diego, CA (USA), 5-9 May 1991). Order Number DE91010055. Source: OSTI; NTIS; GPO Dep.

A prototype system has been developed to view the coolant inside the piping of an operating nuclear plant during off-normal operating conditions. This system provided information on the flow regimes at various states of the operating transient, as well as providing visual information on the void fraction in the coolant. Two configurations were constructed and tested. This paper presents the design for both of the optical in-pipe viewing systems. 1 ref., 7 figs.

14631 (EGG-MS–9254) **Review of inservice inspection and nondestructive examination practices at DOE Category A test and research reactors.** Anderson, M.T.; Aldrich, D.A. EG and G Idaho, Inc., Idaho Falls, ID (USA). Sep 1990. 91p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. Order Number DE91010080. Source: OSTI; NTIS; INIS; GPO Dep.

In-service inspection (ISI) programs are used at commercial nuclear power plants for monitoring the pressure boundary integrity of various systems and components to ensure their continued safe operation. The Department of Energy (DOE) operates several test and research reactors. This report represents an evaluation of the ISI and nondestructive examination (NDE) practices at five DOE Category A (> 20 MW thermal) reactors as compared, where applicable, to the current ISI activities of commercial nuclear power facilities. The purpose of an inservice inspection (ISI) program is to establish regular surveillance of safety-related components to ensure their safe and reliable operation. The integrity of materials comprising these components is generally monitored by means of periodic nondestructive examinations (NDE), which, if appropriately performed, provide methods for identifying degradation that could render components unable to perform their intended safety functions. The reactors evaluated during this review were the Experimental Breeder Reactor 2 and the Fast Flux Test Facility (liquid-metal cooled plants), the Advanced Test Reactor and the High Flux Isotopes Reactor (light-water cooled reactors), and the High Flux Beam Reactor (a heavy-water cooled facility). Although these facilities are extremely diverse in design and operation, they all have less stored energy, smaller inventories of radionuclides, and generally, more remote locations than commercial reactors. However, all DOE test and research facilities contain components similar to those of commercial reactors for which continued integrity is important to maintain plant safety. 10 refs., 6 tabs.

14632 (HW–41677) **D-Reactor incident, January 6, 1956: investigation committee recommendations.** Maguire, A.R. Hanford Works, Richland, WA (USA). 10 Feb 1956. 2p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91008663. Source: OSTI; NTIS; GPO Dep.

A study of the existing procedures covering Beckman amplifier range changing has been made in accordance with General Recommendation No. 4 of the reference committee report. It was concluded that no increase in reactor safety would be realized by the assignment of Operations personnel to the task of making Beckman amplifier range changes, either during reactor startups of normal operation.

14633 (HW–64966) **Tubing fitting failure and subsequent line heater damage: H-1 Loop.** Dearing, F.E. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 29 Apr 1960. 24p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009384. Source: OSTI; NTIS; GPO Dep.

On April 13, 1960 an instrument line was blown from its fitting on the H-1 loop. The Loop was operating at elevated pressure and temperature at the time. Although two men were in the immediate vicinity of the failure when it occurred, fortunately, no injuries or

personnel over-exposure resulted. During the rapid depressurization of the Loop, and because of malfunctions in the line heater temperature control circuit, the line heaters and a portion of the loop piping were damaged. This report is intended to describe the accident and to set forth the observations and recommendations resulting from investigations of the accident and the damage to the Loop. 17 figs.

14634 (INIS-mf–12784, pp. 1-8) **Statistical analysis of fire events at US nuclear power plants.** Hammad, F.H. (Atomic Energy Authority Cairo (Egypt). Nuclear Regulatory and Safety Center); Rashad, S.M. Egyptian Society of Nuclear Sciences and Applications, Cairo (Egypt). 1988. 429p. (CONF-8803238–: 4. conference of nuclear sciences and applications, Cairo (Egypt), 6-10 Mar 1988). In *Proceedings of the fourth conference of nuclear sciences and applications. V. I. Nuclear reactors. Nuclear fuel cycle.* Order Number DE91003075. Source: OSTI; NTIS (US Sales Only); INIS.

The concern about fires as a potential agent of common cause failure in NPPs has greatly increased since the Browns Ferry NPP fire. Several regulatory actions were initiated following this incident. In investigating the chances of fire incident leading to core melt it is found that the unconditional frequency is about 1x10 incidents per reactor-year. The detailed reviews of fire events at nuclear plants are used in quantifying fire occurrence frequency required to carry out fire risk assessment. In this work the results of a statistical analysis of 354 fire incidents at US NPPs in the period from January 1965 to June 1985 are presented to quantify fire occurrence frequency. The distribution of fire incidents between the different types of NPPs (PWR, BWR or HTGR), the mode of plant operation, the probable cause of fire, the type of detectors detect the incident, who extinguished the fire, suppression equipment, suppression agent, the initiating combustible, the component or components affected by fire are all analysed for the studied 354 fire incidents. More than 50% of the incidents occurred during the construction phase, in many of them there is neither nuclear problem nor any safety problem, however these incidents delayed the startup of the units up to 2 years as happened in Indian Point unit 2 (1971). There are four major fire incidents at US NPPS in the first period of the study (1965-1978), not one of them in the last seven years (1979-1985) which clarify the development in the fire protection measures and technology. The fire events in US (NPPS) can be summarized in about 354 incidents at 33 locations due to 38 causes of fire with 0.17 fire events/plant/year.

14635 (INIS-mf–12806, pp. 278-289) **A pilot program for the development of an alternative approach to seismic equipment qualification.** Yanev, P.I. (EQE, Inc., San Francisco, CA (USA)); Swan, S.W. Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

This report is a summary of the two-volume Pilot program report: program for the development of an alternative approach to seismic equipment qualification (Yanev and Swan, 1982). The pilot program was undertaken to determine the feasibility of assessing the seismic adequacy of equipment in nuclear power plants based on evaluation and application of data to be acquired from equipment in non-nuclear power facilities that have been subjected to strong-motion earthquakes. Application of the data would provide a valid basis for assessing the need for subsequent qualification efforts.

14636 (INIS-mf–12806, pp. 291-305) **Seismic reliability proving program at NUPEC, Japan.** Ohmori, T. (Nuclear Power Engineering Workshop, Tokyo (Japan)); Kanayama, T.; Watanabe, K. Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Japan is a country of earthquakes, and the public is concerned about the possibility of large-scale earthquakes. Since seismic design is composed of complex calculations, however, the validity of the analytical techniques employed is not always understood by the general public. For this reason, it was decided to confirm the seismic safety and reliability of simulated models representing actual systems, components and equipment using an appropriate vibration test facility. The facility, including a large vibration table, was completed at the Tadotsu Engineering Laboratory of NUPEC with the assistance of MITI in July 1982.

14637 (INIS-mf–12807, pp. 10.8-10.17) **Recent developments in radiation protection at power reactors.** Chase, W.J. (Ontario Hydro, Pickering, ON (Canada). Pickering Generating Station). Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Retubing (removal and replacement of the pressure tubes) of Reactor Units 1 and 2 at Pickering NGS was the largest rehabilitation project over completed in the nuclear power industry in Canada. The project was complicated by the discovery of carbon-14 particulate during the rehabilitation. Advances in radiation protection in the areas of protective clothing, dosimetry, instrumentation, dose reduction techniques, and management techniques were necessary for the successful completion of the retubing project. Other advances that occurred independently of retubing will also be discussed.

14638 (INIS-SU–231, pp. 78-82) **Assessment of permissible releases in case of accidental loss of coolant and sodium coolant burning.** Zybin, V.A.; Ivanchenko, V.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Assessment of permissible releases in case of maximum credible accident of SNR reactor (loss of coolant in primary burning) is carried out. Attention is paid to release of radioactive aerosols to service rooms and to assessment of permissible single ejections to atmosphere. In case of aerosols release to neibouring rooms internal irradiation of people due to radioactive aerosols intake through respiratory system is defining. Radiation hazard from aerosols, resulting from coolant burning, is mainly contributed by ^{24}Na. To reduce irradiation doses decrease ^{137}Cs content in coolant is recommended.

14639 (INIS-SU–231, pp. 68-71) **Decontamination is a measure for decreasing personnel exposure.** Limko, Eh.G.; Ryazanov, O.M.; Zinchenko, A.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Cost-benefit analysis of advisability of preparation decontamination of WWER reactor circuit equipment is presented. It is shown that decontamination expediency is determined by estimation of expected decontamination effect. For this purpose comparison of the body of repair works on the given equipment, expected collective doses and costs resulting from the chosen decontamination method and required washout coefficient should be carried out.

14640 (JAERI-M–90-202) **The effects of water environments on crack growth behavior of LWR pressure vessel steels.** Onizawa, Kunio (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Watanabe, Teruo; Ebine, Noriya; Nakajima, Nobuya. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 40p. (In Japanese). Order Number DE91767876. Source: OSTI; NTIS (US Sales Only); INIS.

Nuclear power plants of light water reactor type in Japan have been operated for 20 years since 1970. The evaluation of their operationable period, that is, their residual lifetime based on aging degradation is getting more important. Reactor pressure vessel (RPV) is considered as one of the most important components which control the engineering life of a plant. The life of RPV can be evaluated by two degradation mechanisms, crack growth and irradiation embrittlement based on fracture mechanics. This report describes the complicated effects of water environments, flow rate, dissolved oxygen (D.O.) and temperature, and sulfur content in steel on crack growth behavior. It was identified that the lower flow rate and the higher D.O., the higher crack growth rate. In addition, crack branching was observed in medium sulfur steel at 200degC and 250degC in cases of low flow rate and/or high D.O. On the other hand, crack growth tests of low sulfur steel showed little effect of water environments. It was suggested that the development of quantitative crack growth model was essential to evaluate the life considering these effects of environments. (author).

14641 (NUREG/CP–0116-Vol.1) **Proceedings of the 21st DOE/NRC Nuclear Air Cleaning Conference: Sessions 1–6.** First, M.W. (ed.)— (Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab.). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. Feb 1991. 560p. Sponsored by USDOE, Washington, DC (USA); Nuclear Regulatory Commission, Washington, DC (USA). (CONF-900809–Vol.1: 21. DOE/NRC nuclear air cleaning conference, San Diego, CA (USA), 13-16 Aug 1990). Source: OSTI; NTIS; INIS; GPO.

Separate abstracts have been prepared for the papers presented at the meeting on nuclear facility air cleaning technology in the following specific areas of interest: air cleaning technologies for the management and disposal of radioactive wastes; Canadian waste management program; radiological health effects models for nuclear power plant accident consequence analysis; filter testing; US standard codes on nuclear air and gas treatment; European community nuclear codes and standards; chemical processing off-gas cleaning; incineration and vitrification; adsorbents; nuclear codes and standards; mathematical modeling techniques; filter technology; safety; containment system venting; and nuclear air cleaning programs around the world. (MB)

14642 (NUREG/CR–3916) **Pressurized melt ejection into water pools.** Tarbell, W.W. (Sandia National Labs., Albuquerque, NM (USA)): Pilch, M.; Ross, J.W.; Oliver, M.S.; Gilbert, D.W.; Nichols, R.T. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Sandia National Labs., Albuquerque, NM (USA); Ktech Corp., Albuquerque, NM (USA). Mar 1991. 97p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC04-76DP00789. (SAND–84-1531). Source: OSTI; NTIS; INIS; GPO.

Direct Containment Heating is important because it is one of the postulated methods for early containment failure. If the reactor pressure vessel (RPV) should fail at an instrument tube penetration in the lower head, the resulting aperture would allow the molten core material to be discharged at high velocity into the cavity. Scaled experiments have demonstrated that the gas discharged during blowdown of the pressure system can entrain core debris and carry it out of the cavity region. Although these experiments were performed with the cavity initially devoid of water, other tests with the cavity partially filled with water exhibited similar results. The objective of the work described here is twofold: (1) to study the jet ejection and debris dispersal behavior when water is in contact with the lower head of the RPV and completely fills the cavity; and, (2) to compare the results of an experiment where the cavity is partially filled with water. These tests are of interest not only because they consider the dispersal of water and debris from the cavity but they also consider the potential consequences of codispersing water with core debris into the containment. Because the core debris may impart sufficient energy to the containment atmosphere to raise the pressure to potentially threatening levels, it is important to identify possible mitigating mechanisms. Analytical efforts have suggested that the codispersed water may act as a finely distributed heat sink that would have the beneficial effect of absorbing debris energy. This has not been confirmed experimentally, although the work presented here does attempt to identify the potential for water preexisting in the cavity to be dispersed as small droplets. 17 refs., 41 figs., 12 tabs.

14643 (NUREG/CR–5139) **Dose-reduction techniques for high-dose worker groups in nuclear power plants.** Khan, T.A. (Brookhaven National Lab., Upton, NY (USA)); Baum, J.W.; Dionne, B.J. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications; Brookhaven National Lab., Upton, NY (USA). Mar 1991. 77p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC02-76CH00016. (BNL-NUREG–52278). Source: OSTI; NTIS; INIS; GPO.

This report summarizes the main findings of a study of the extent of radiation dose received by special work groups in the nuclear power industry. Work groups which chronically get large doses were investigated, using information provided by the industry. The tasks that give high doses to these work groups were examined and techniques described that were found to be particularly successful in reducing dose. Quantitative information on the extent of radiation doses to various work groups shows that significant numbers of workers in several critical groups receive doses greater than 1 and even 2 rem per year, particularly contract personnel and workers at BWR-type plants. The number of radiation workers whose lifetime dose is greater than their age is much less. Although the techniques presented would go some way in reducing dose, it is likely that a sizeable reduction to the high-dose work groups may require development of new dose-reduction techniques as well as major changes in procedures. 10 refs., 26 tabs.

14644 (NUREG/CR–5282) **Estimation of containment pressure loading due to direct containment heating for the Zion Plant.** Tutu, N.K. (Brookhaven National Lab., Upton, NY (USA)); Ginsberg, T.; Park, C.K.; Grimshaw, C.A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Brookhaven National Lab., Upton, NY (USA). Mar 1991. 51p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC02-76CH00016. (BNL-NUREG–52181). Source: OSTI; NTIS; INIS; GPO.

For some core meltdown accident sequences in light water reactors (LWRs) it is possible for the primary system to remain at high pressure. Under these circumstances, as the molten core debris penetrates the reactor vessel, the core debris would be ejected under high pressure and, subsequently, dispersed into the containment atmosphere. During the process, thermal and chemical energies are directly transferred from the core debris to the containment atmosphere. This phenomenon has become known as direct containment heating (DCH). This report presents the results of a series of calculations at Brookhaven National Laboratory (BNL) to provide estimates of the DCH containment pressure loading in the Zion plant subject to a wide range of initial conditions and phenomenological assumptions. The containment loading calculations were performed using a version of the CONTAIN code with update modifications, which parametrically characterize DCH phenomena (CONTAIN-DCH, Version 1.10). The range of calculation parameters was selected to represent many of the current uncertainties in DCH initial conditions and uncertainties in modeling DCH phenomena. The choice of CONTAIN calculation input parameters is discussed and results are presented for both a seven-cell nodalization of the Zion containment building. The seven-cell calculations incorporate all the features of the CONTAIN-DCH model. The single-cell calculations are included only for comparison purposes and represent upper-bound estimates of DCH loads, assuming complete mixing, adiabatic conditions and thermal equilibrium between the gas and core debris. Calculation results are presented and discussed. 16 refs., 12 figs., 8 tabs.

14645 (NUREG/CR–5309) **Closeout of IE Bulletin 83-07: Apparently fraudulent products sold by Ray Miller, Inc.** Foley, W.J. (Parameter, Inc., Elm Grove, WI (USA)); Dean, R.S.; Hennick, A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Operational Assessment: Parameter, Inc., Elm Grove, WI (USA). Mar 1991. 38p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). (PARAMETER/IE–200). Source: OSTI; NTIS; INIS; GPO.

Documentation is provided in this report for the closeout of IE Bulletin 83-07 regarding apparently fraudulent products sold by Ray Miller, Inc., to nuclear power and fuel facilities. The bulletin and two supplements were issued to all holders of nuclear power reactor or fuel facility operating licenses or construction permits. Four actions were required of all affected facilities to provide assurance that fraudulent items are not used in safety-related applications, unless qualified by tests. Review of utility responses and NRC/Region inspection reports shows that the bulletin is closed for all of the 118 power facilities and for the two fuel facilities to which it was issued for action. Facilities where were shut down or had construction halted indefinitely or permanently at the time of issuance of this report are not included. It is concluded that all bulletin concerns have been resolved.

14646 (NUREG/CR–5658) **FPFPspace2: A code for following airborne fission products in generic nuclear plant flow paths.** Owcarski, P.C. (Pacific Northwest Lab., Richland, WA (USA)); Burk, K.W.; Ramsdell, J.V.; Yasuda, D.D. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution; Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 78p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC06-76RL01830. (PNL–7513). Source: OSTI; NTIS; INIS; GPO.

In order to assure that a nuclear power plant control room remains habitable during certain types of postulated accidents, Pacific Northwest Laboratory (PNL) has undertaken a special study for the US Nuclear Regulatory Commission. This purpose of this study is to develop software that can aid in the analyses of control room habitability during accidents in which airborne fission products could challenge internal air pathways to the control room. PNL has completed an initial version (FPFP) and final version (FPFP 2) of a software package that can estimate the unsteady-state invasion of quantities of fission products into the control room or any other destination within the nuclear plant via generic internal flow paths. This report consists of three parts: Section 2.0, Technical Bases, describes the flow path components and mechanisms of natural fission product deposition; Section 3.0, FPFP 2 Code Description, describes code organization and the functions of the subroutines; and Section 4.0, Code Operation, discusses details of input requirements, code output, and a sample case demonstration. The appendices consist of an FPFP 2 Fortran code listing, a listing of a code for building input files, forms for building input files, and the sample case input and output files. 7 refs., 3 figs.

14647 (PNL–7223-HEDR) **Uncertainties in source term calculations generated by the ORIGEN2 computer code for Hanford Production Reactors: Hanford Environmental Dose Reconstruction Project.** Heeb, C.M. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 43p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009815. Source: OSTI; NTIS; INIS; GPO Dep.

The ORIGEN2 computer code is the primary calculational tool for computing isotopic source terms for the Hanford Environmental Dose Reconstruction (HEDR) Project. The ORIGEN2 code computes the amounts of radionuclides that are created or remain in spent nuclear fuel after neutron irradiation and radioactive decay have occurred as a result of nuclear reactor operation. ORIGEN2 was chosen as the primary code for these calculations because it is widely used and accepted by the nuclear industry, both in the United States and the rest of the world. Its comprehensive library of over 1,600 nuclides includes any possible isotope of interest to the HEDR Project. It is important to evaluate the uncertainties expected from use of ORIGEN2 in the HEDR Project because these uncertainties may have a pivotal impact on the final accuracy and credibility of the results of the project. There are three primary sources of uncertainty in an ORIGEN2 calculation: basic nuclear data uncertainty in neutron cross sections, radioactive decay constants, energy per fission, and fission product yields; calculational uncertainty due to input data; and code uncertainties (i.e., numerical approximations, and neutron spectrum-averaged cross-section values from the code library). 15 refs., 5 figs., 5 tabs.

14648 (PNL–7636) **HUDU: The Hanford Unified Dose Utility computer code.** Scherpelz, R.I. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 339p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009682. Source: OSTI; NTIS; INIS; GPO Dep.

The Hanford Unified Dose Utility (HUDU) computer program was developed to provide rapid initial assessment of radiological emergency situations. The HUDU code uses a straight-line Gaussian atmospheric dispersion model to estimate the transport of radionuclides released from an accident site. For dose points on the plume centerline, it calculates internal doses due to inhalation and external doses due to exposure to the plume. The program incorporates a number of features unique to the Hanford Site (operated by the US Department of Energy), including a library of source terms derived from various facilities' safety analysis reports. The HUDU code was designed to run on an IBM-PC or compatible personal computer. The user interface was designed for fast and easy operation with minimal user training. The theoretical basis and mathematical models used in the HUDU computer code are described, as are the computer code itself and the data libraries used. Detailed instructions for operating the code are also included. Appendices to the report contain descriptions of the program modules, listings of HUDU's data library, and descriptions of the verification tests that were run as part of the code development. 14 refs., 19 figs., 2 tabs.

14649 (SAND–89-1786) **Analysis of core damage frequency due to fire at the Savannah River K-Reactor.** Lambright, J.A.; Daniel, S.L.; Brosseau, D. Sandia National Labs., Albuquerque, NM (USA). Jan 1991. 176p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009187. Source: OSTI; NTIS; INIS; GPO Dep.

In keeping with the philosophy of the external events analyses for NUREG-1150, which are intended to be smart probabilistic risk assessments (PRAs) making full use of all insights gained during the past 10 years of development in risk assessment methodologies, the Savannah River K-Reactor fire analysis was performed using newly developed and simplified methods. These methods have been under development at Sandia National Laboratories under sponsorship of the Nuclear Regulatory Commission (NRC) Division of Risk Assessment as part of the Dependent Failure Methodology Development Program. A detailed screening analysis was performed which showed most plant areas had a negligible contribution to fire-induced core damage frequency. Detailed analysis of the fire risk resulted in a total (mean) core damage frequency of 1.35E-7 per year. 18 refs., 12 figs., 17 tabs.

14650 (WHC-SA–0988) **Fatigue evaluation of piping systems with limited vibration test data.** Huang, S.N. Westinghouse Hanford Co., Richland, WA (USA). Nov 1990. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. (CONF-910602–6: American Society of Mechanical Engineers (ASME) pressure vessels and piping conference, San Diego, CA (USA), 23-27 Jun 1991). Order Number DE91007167. Source: OSTI; NTIS; INIS; GPO Dep.

The safety-related piping in a nuclear power plant may be subjected to pump- or fluid-induced vibrations that, in general, affect only local areas of the piping systems. Pump- or fluid-induced vibrations typically are characterized by low levels of amplitudes and a high number of cycles over the lifetime of plant operation. Thus, the resulting fatigue damage to the piping systems could be an important safety concern. In general, tests and/or analyses are used to evaluate and qualify the piping systems. Test data, however, may be limited because of lack of instrumentation in critical piping locations and/or because of difficulty in obtaining data in inaccessible areas. This paper describes and summarizes a method to use limited pipe vibration test data, along with analytical harmonic response results from finite-element analyses, to assess the fatigue damage of nuclear power plant safety-related piping systems. 5 refs., 2 figs., 11 tabs.

14651 (WSRC-MS–90-20) **The potential for fuel-target mixing during a fuel melting accident in an SRS fuel assembly.** Ellison, P.G. (Westinghouse Savannah River Co., Aiken, SC (USA)); Epstein, M.; Coryell, E.W. Westinghouse Savannah River Co., Aiken, SC (USA). [1990]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. (CONF-900917–37: American Nuclear Society (ANS) topical meeting on

safety of commercial nuclear reactor research and irradiation facilities, Boise, ID (USA), 30 Sep - 3 oct 1990). Order Number DE91009340. Source: OSTI; NTIS; INIS; GPO Dep.

The mechanical work potential during a whole core melting accident in the Savannah River Site production reactors is strongly influenced by the amount of target material mixing with the fuel. This strong fluence on accident progression is the result of the potential for recriticality of the fuel and the possibility of steam explosions with the molten fuel-target material. In this paper an analysis of the temperature and draining history of the fuel film/target wall composite is made on the basis of conduction theory. The formulation includes the effects of turbulent fuel-film flow and finite target wall/fuel-film geometry. The computational procedure results in predictions of the fraction of the deposited fuel that is likely to mix with the substrate material as a function of target wall thickness and length of the fuel deposit. 3 refs., 3 figs.

14652 (WSRC-MS–90-205) **Air-water hydraulics modeling for a Mark-22 fuel assembly with RELAP5.** Dimenna, R.A. (Westinghouse Savannah River Co., Aiken, SC (USA)); Caraher, D.L. Westinghouse Savannah River Co., Aiken, SC (USA). [1990]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. (CONF-9009219–8: 1990 joint RELAP5 and TRAC-BWR international user seminar, Chicago, IL (USA), 17-21 Sep 1990). Order Number DE91009323. Source: OSTI; NTIS; INIS; GPO Dep.

The RELAP5/MOD2.5 computer program is being used to simulate hypothetical loss-of-coolant accidents in the SRS production reactors. Because of their unique geometry and thermal-hydraulic design these reactors pose a significant challenge to the simulation capability of RELAP5. This paper focuses on one aspect of the LOCA simulations, air-water flow through the fuel assemblies. Deficiencies in the RELAP5 treatment of wall friction and interfacial friction are described along with proposals to extend these models to encompass the Savannah River Site reactor fuel assembly hydraulics. A modeling technique to allow RELAP5 to reproduce experimentally observed weir flow at the fuel assembly inlet is also described.

14653 (WSRC-RP–89-820) **Reactor operation safety information document.** Westinghouse Savannah River Co., Aiken, SC (USA). [1990]. 312p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. Order Number DE91009300. Source: OSTI; NTIS; INIS; GPO Dep.

The report contains a reactor facility description which includes K, P, and L reactor sites, structures, operating systems, engineered safety systems, support systems, and process and effluent monitoring systems; an accident analysis section which includes cooling system anomalies, radioactive materials releases, and anticipated transients without scram; a summary of onsite doses from design basis accidents; severe accident analysis (reactor core disruption); a description of operating contractor organization and emergency planning; and a summary of reactor safety evolution. (MB)

24 POWER TRANSMISSION AND DISTRIBUTION

Refer also to citation(s) 14482

2401 Power Systems

Refer also to citation(s) 15991

14654 (LUTEDX-TEIE–5054-1-47-90) **Load predictions in low voltage networks.** Flygare, N. Lund Univ. (Sweden). Dept. of Industrial Electrical Engineering and Automation. Oct 1990. 52p. (In Swedish). Order Number DE91763548. Source: OSTI; NTIS (US Sales Only).

Examination paper.

This report presents a suggestion of how to suit a method for prediction of power loads in low voltage networks to the Design and Management system named SWE-DAM. The software package SWE-DAM, developed by Sydkraft AB, contains a program which predicts the power demand using Velanders formula. The Association of Swedish Electric Utilities has developed another software program which predicts hourly powerload graphs from different categories of customers. This program uses a method developed at the Department of Heating and Power Engineering at the Lund Univ. The method has a better possibility, than the Velander formula, to deal with summation of heterogeneous loads, e.g. customers of different categories. The use of powerload prediction has been studied. A thorough description of the two methods is presented. The sequence using load pattern curves has been modified to suit the SWE-DAM software package. A principle of the loadflow-calculation routine is proposed. (author).

2402 Power System Networks, Transmission and Distribution

14655 (BNL-NUREG–44787) **Seismic testing and evaluation of relays past and future.** Bandyopadhyay, K.; Hofmayer, C. Brookhaven National Lab., Upton, NY (USA). [1990]. 8p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9010185–26: 18. water reactor safety information meeting, Gaithersburg, MD (USA), 22-24 Oct 1990). Order Number DE91009464. Source: OSTI; NTIS; INIS; GPO Dep.

Brookhaven National Laboratory (BNL) is conducting a special study on relays. The primary objective of the first series of relay tests was to study systematically the influence of relay design and input motion on seismic capability. The second test series will address some fundamental questions regarding the relay chatter acceptance criteria in addition to the chatter tolerance behavior of a breaker circuit. The characteristics of each relay model as observed from the single frequency test data of the first test series and an outline of the plans for the second test series are described in this paper. 3 refs., 1 tab.

14656 (CONF-9104163–4) **Influence of channel base current and varying return stroke speed on the calculated fields of three important return stroke models.** Thottappillil, R. (Florida Univ., Gainesville, FL (USA). Dept. of Electrical Engineering); Uman, M.A.; Diendorfer, G. Florida Univ., Gainesville, FL (USA). Dept. of Electrical Engineering; Oak Ridge National Lab., TN (USA). 16 Apr 1991. 10p. Sponsored by USDOE, Washington, DC (USA); National Science Foundation, Washington, DC (USA). DOE Contract AC05-84OR21400. Grant ATM 8807449. From 1991 international conference on lightning and static electricity; Cocoa Beach, FL (USA); 16-19 Apr 1991. Order Number DE91010786. Source: OSTI; NTIS; GPO Dep.

Recently Nucci et al. compared five return stroke models using an identical current at the chemical base of each. Diendorfer and Uman introduced a new model which reproduces remarkably well the experimentally observed characteristics of the fields both close to and far from the return stroke channel. Both Nucci et al. and Diendorfer and Uman used a channel base current that is typical of measured subsequent stroke current of both natural lightning and triggered lightning. Though the channel base current adopted in each paper is within the range of measured currents, they differ in the detailed wave shape. The first part of this paper compares the calculated fields of the Traveling Current Source (TCS), Modified Transmission Line (MTL), and the Diendorfer-Uman (DU) models with a channel base current assumed in Diendorfer and on the hand and with the channel base current assumed in Nucci et al. on the one hand and with the channel base current assumed in Diendorfer and Uman on the other hand. The characteristics of the field wave shapes are shown to be very sensitive to the channel base current, especially the field zero crossing at 100 km for the TCS and DU models, and the magnetic hump after the initial peak at close range for the TCS model. In the second part of the paper the DU model is theoretically extended to include any arbitrarily varying return stroke speed with height and a brief discussion is presented of the effects of an exponentially decreasing speed with height on the calculated fields for the TCS, MTL, and DU models. 4 refs., 4 figs.

14657 (DEFU-KR–85(pt.1)) **Constant voltage control in a distribution network: Main report.** Danske Elvaerkers Forenings Udredningsafdeling (DEFU), Lyngby (Denmark). Mar 1990. 76p. (In

Danish). Order Number DE91763408. Source: OSTI; NTIS (US Sales Only).

The report describes the principles fundamental to voltage regulators used in power distribution systems. (AB).

14658 (DEFU-KR–85(pt.2)) **Constant voltage control in a distribution network: Appendix and supplement.** Danske Elvaerkers Forenings Udredningsafdeling (DEFU), Lyngby (Denmark). Mar 1990. 84p. (In Danish). Order Number DE91763409. Source: OSTI; NTIS (US Sales Only).

Description of methods for the adjustment of electric power generators in a power distribution network. (AB).

14659 (DEFU-KR–85(pt.3)) **Constant voltage control in a distribution network: Instructions for adjusting voltage regulators.** Danske Elvaerkers Forenings Udredningsafdeling (DEFU), Lyngby (Denmark). Mar 1990. 31p. (In Danish). Order Number DE91763410. Source: OSTI; NTIS (US Sales Only).

Practical instructions on the adjustment of voltage regulators used in connection with power distribution networks. (AB).

14660 Dielectric gas blast high voltage circuit breaker. Thuries, E.; Dufournet, D.; Perret, M. 30 Nov 1990. Filed date 30 May 1990. Canada Patent patent application 2017804. 18p. (In French). Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A high-voltage circuit breaker comprises, within a sealed isolating envelope filled with dielectric gas, a fixed and a movable assembly, a gas-blast volume elongated by a blast nozzle, a gas-blast piston, and a pair of secondary contacts. The fixed assembly consists notably of a main fixed contact and a fixed arc contact. The movable assembly is moved by a maneuvering rod and notably comprises a main movable contact and a movable arc contact. The secondary contacts are disposed in a first volume and are intended for generating a secondary arc. The circuit breaker is characterized in that it includes first means for reducing the risks of untimely detonation due to the secondary arc. These means consist of a sleeve of insulating material, extending to the right of the secondary contacts and in sliding contact with at least one part of one of the secondary contacts. The sleeve has longitudinal slots on the side of the secondary contact. 8 figs.

14661 Measuring equipment with an auxiliary electrode for a gas-insulated, enclosed high-voltage power station. Gorablenkow, J. 22 Sep 1990. Filed date 20 Mar 1990. Canada Patent patent application 2012570. 15p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull. Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

The measuring equipment of this invention is inserted into a projection of an enclosure. Its auxiliary electrode forms, together with an inner conductor, a high-end voltage capacitor of a capacitive voltage divider and is connected to the enclosure by means of an undervoltage capacitor. A test connector is guided in a gas-tight arrangement out of the projection and connected to an indicator or measuring instrument. To also detect high-frequency transient phenomena, the undervoltage capacitor comprises two cones fitted inside one another with a solid dielectric between them. A terminating resistor, which is connected to the inner conductor of a gas-tight coaxial plug, is disposed in the inner cone. The terminating resistor is matched to the characteristic impedance of the coaxial plug and that of the test connector. The measuring equipment with the auxiliary electrode can be inserted into tubular gas connections in the enclosure of a high-voltage power station, particulary compressed-gas-insulated enclosed high-voltage switching stations. The invention provides measuring equipment with an auxiliary electrode for voltage measurement which has on one hand a high natural resonance frequency, permitting a very high upper cut-off frequency for the voltages to be measured, and on the other hand also makes possible the measurement of the operating frequency alternating voltage. 2 figs.

14662 Semiconductor electric power conversion system. Bando, Akira; Tanaka, Chikara; Saito, Keiji; Kawai, Tadao; Kita, Eizo; Mihashi, Keiichi; Ohno, Yasuteru; Nakagawa, Hiroto. 20 Sep 1990. Filed date 20 Mar 1990. Canada Patent patent application 2012578. 49p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

This invention relates to an electric power conversion system used in the field of power systems, electric railways, large-scale plants or the like, particularly for ac-to-dc conversion, dc power transmission, or frequency conversion systems in those fields. It is particularly suitable for use in a variable speed electric generator and motor unit which is required to continue operation to its limit even in cases where the ac input voltage is unstable owing to abnormal conditions in the electric power system. The conversion system of the invention comprises a multiphase bridge circuit composed of semiconductors such as thyristors and an associated firing circuit. It is so constructed that if the ac input current flowing in the bridge is equal to or larger in value than the dc output current flowing out of the bridge circuit, it will be decided that there is an inner defect or fault, and possible worsening of the defect will be prevented by disabling the firing circuit to extinguish the thyristors in the bridge circuit. If the ac input current is smaller than the dc output current, the bridge is permitted to continue the power conversion operation, thus eliminating unnecessary interruption which otherwise would be caused by exterior disturbances. In addition, the system of the invention may be equipped with a device to prevent adverse effects from being caused by an abnormal rise of the temperature of the thyristors. 22 figs.

14663 Metal-clad compressed gas-blast circuit-breaker. Chyla, T.; Meinherz, M. 18 Sep 1990. Germany, F.R. Patent priority P39041484;CA patent application 2009298. 20p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A metal-clad gas-blast circuit breaker has a gas-filled housing and an interrupter unit supported in the housing by a hollow post insulator. The circuit breaker has a shifting linkage with at least one insulating drive rod. The shifting linkage transmits the switching motion from a driving mechanism to a movable switching contact. In order to reduce the overall axial length of the circuit breaker, the hollow post insulator, comprising only insulating material, is penetrated only by the insulating drive rod and has a premolded flanged ring mounted axially set back from the edge and adapted to the bearing ring of the housing. The flanged ring serves as an outer support mounted on the housing. The circuit breaker of this invention is especially suited for application in gas-insulated, metal-clad high-voltage switching stations. 5 figs.

14664 Electrical fault detecting device. Mutch, A.J.; Sheldon, R. 17 Jul 1990. Filed date 7 Dec 1989. Canada Patent patent application 2004890. 47p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

An apparatus for determining incorrect usage or illegal tampering with an ac electricity supply to a metering device is disclosed. The apparatus has a first signal generating means, disposed at a first location in the supply, for generating a first signal which varies with a property of the electricity supply in the vicinity of the first location. Second signal generating means are disposed at a second location in the supply for generating a second signal which varies with a property of the electricity supply in the vicinity of the second location. Monitoring and actuator means are adapted to monitor the two signals and to produce a third actuating signal when the first and second signals are inconsistent with a correct electricity supply. The signal generating means may, for example, comprise a coiled portion of one or more cables forming part of the supply to produce a magnetic flux signal. Alternatively, or in addition, the signal generating means may comprise a coil positioned around a cable forming part of the electricity supply. The signal generating means may also take the form of a device for producing a signal which varies with the rotation of a meter disc. 9 figs.

2403 Power Transmission Lines and Cables

14665 (CRIE-T–89067) **Application of lightning arrester on transmission lines.** Matsubara, K. (Central Research Institute of

Electric Power Industry, Tokyo (Japan)). Central Research Inst. of Electric Power Industry, Komae, Tokyo (Japan). Energy and Environment Lab. May 1990. 31p. (In Japanese). Order Number DE91764239. Source: OSTI; NTIS (US Sales Only).

A lightning arrester on transmission lines is expected to reduce lightning incidents and applied number of phases becomes larger. But, the problems of application guide to be established such as the applying method, the treating capacity for lightning energy and the coordination to an arc horn remain as they are. The applying method of a lightning arrester on transmission lines and the effect are examined from the viewpoint of generating incident on transmission lines by lightning and the operating viewpoint of a lightning arrester for a 77kV system. The double circuit setup of an arrester is the best method to reduce the lightning incidents and the single circuit setup can reduce the incident rate by 40% through the effect preventing the flashover of the circuit on which the arrester is not set up. For installing an arrester on a short section, the flashover point can transfer to the next steel tower where the arrester is not set up, only when lightning the last steel tower. Inflowing current into an arrester by a direct lightning is considerably large and the treating energy at the time becomes large but this energy can be expected to be reduced by the operation of the arrester set up on another steel tower. 7 refs., 15 figs., 6 tabs.

14666 Heat-generative electric wire. Sasaki, Junichi. 6 Oct 1990. Filed date 4 Apr 1990. Canada Patent patent application 2013792. 23p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

An object of this invention is to provide a heat-generating electric wire which can generate a sufficiently large amount of heat, even in the case of low power transmission, to melt snow or ice formed on overhead power lines, and which will not be excessively heated if a large amount of electric power is transmitted. Another object is to provide a heat-generating wire in which the electrolytic corrosion of the overhead wire can be prevented. These objects are attained by the wire of this invention, which includes a Ni-Fe series alloy wire member containing 45-80 wt % Ni (the remainder being Fe) and which is wound on or stranded with the outermost layer of an overhead electric wire. The Ni-Fe series alloy is preferably made to have a metal coating such as Zn formed on its surface in order to increase the heat generation capability of the wire and to inhibit electrolytic corrosion of the overhead wire. 11 figs.

14667 Insulator. Nakajima, Isao; Ikami, Toshiichi. 17 Sep 1990. Filed date 16 Mar 1990. Canada Patent patent application 2012424. 13p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

The insulating properties of transmission line insulators are reduced when the insulator becomes contaminated. Such contamination is promoted by the adherence of rainwater including dusts and/or absorbing of dusts and gas when the insulated surface is wetted with rainwater. It is known to treat insulators with water repellent compounds to avoid this problem, but known treatments have certain disadvantages such as loss of water repellency in a short time. An object of this invention is to overcome these disadvantages and to provide an insulator having a high usefulness and excellent water repellency which can be easily treated and maintained over a long period of time. It has been found that if a glass layer itself forming the surface of the insulator has water repellent properties, the water repellency of the insulator surface is not lost. According to the invention, the glassy surface is treated with silane or silazane to provide a surface layer of the proper water repellency. The insulator surface may be preferably treated in such a manner that the insulator is immersed in a bath of silane or silazane. Experiments are described to illustrate the performance of insulators treated according to the invention in comparison to non-treated insulators. 1 fig., 1 tab.

25 ENERGY STORAGE

Refer also to citation(s) 14703

2506 Thermal

Refer also to citation(s) 14130

2509 Batteries

14668 (ANL/CP–72112) **Characterization of active materials and electrodes for battery R&D.** Redey, L. Argonne National Lab., IL (USA). [1991]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-910552–9: 179. meeting of the Electrochemical Society, Washington, DC (USA), 5-10 May 1991). Order Number DE91010758. Source: OSTI; NTIS; GPO Dep.

A powerful characterization system and procedure used to measure cell and electrode performance parameters are described. The characterization utilizes an interrupted-galvanostatic cycling technique. Cell voltage, electrode potential, voltage loss, and relaxation are measured under precisely controlled experimental conditions in test cells which are equipped with one or more reference electrodes and voltage taps. These measured quantities are used to evaluate the performance of the test cell or its electrodes. The electrodes and cell are built to mimic the design parameters of a full-size cell. An important quantity calculated from measured data is the area-specific impedance (ASI_t, in units of ohm·cm^2). The measured ASI_t vs utilization plots are used to assess the specific power and specific energy characteristics of full-size battery cells. 12 refs., 7 figs.

14669 (CRIE-T–89074) **Evaluation of cathode materials for high energy lithium secondary batteries.: Electrochemical behavior of vanadium oxides and a manganese oxide.** Terada, N. (Central Research Institute of Electric Power Industry, Tokyo (Japan)); Takei, K.; Ikeya, T.; Iwahori, T. Central Research Inst. of Electric Power Industry, Komae, Tokyo (Japan). Energy and Environment Lab. May 1990. 42p. (In Japanese). Order Number DE91764240. Source: OSTI; NTIS (US Sales Only).

Batteries of higher energy density are desired to realize a load conditioner of longer life and more compact geometry. Experimental researches were carried out by using test batteries using vanadium oxides and a manganese oxide which are expected to theoretically have higher energy density and higher voltage than those of molybdenum sulfide. Characteristic tests were carried out by trially manufacturing test batteries through the selection of vanadium oxides (three kinds) and a managanese oxide as the positive electrode material, indicating that all these materials had about two times larger energy density than that of molybdenum sulfide. Of all tested materials, lithium vanadium oxide (LiV_3O_8) had the maximum energy density (570Wh/kg). It seemed that the close relation existed between the inflection point of the voltage curve and the occupying rate of lithium inserting sites in the crystal composing of positive electrode for LiV_3O_8 material. 24 refs., 17 figs.

14670 (DOE/CH/10406–T3) **Conceptual design study of high-performance sodium/metal chloride batteries for electric vehicle applications: Final technical report.** Beta Power, Inc., Salt Lake City, UT (USA). Jul 1990. 137p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-89CH10406. Order Number DE91009618. Source: OSTI; NTIS; GPO Dep.

The US DOE interest in Sodium/Metal Chloride batteries stems from three major potentialities which this system appears to offer. The first is enhanced battery reliability over its sister technology, Sodium/Sulfur. This is directly related to the short-circuit failure characteristic of metal chloride cells, which, in turn, permits cell networks which take advantage of this failure mode. The second benefit is the inherent safety which stems from the low vapor pressure of the reactants and the tendency for the salt to seal-off small fracture sites in the electrolyte. The low vapor pressure allows rectangular cells to be utilized, which results in excellent packing density of cells within the battery. Finally, the specific energy of the metal chloride battery is comparable to a sodium/sulfur battery, and, as this study has concluded, cell designs are possible which offer substantial performance advantages, especially in volumetric energy density. The workplan that was established for this study was composed of four tasks: cell design, battery design, manufacturing cost and cell development plan. The cell modeling activity led the design efforts by providing design direction and associated

performance figures. Three generic design concepts were explored based on different electrolyte geometries. These included multi-tube (common header), segmented flat plate and bipolar flat plate designs. The first two designs could be designated as either central cathode or outside cathode configurations. Each of these designs offered a large electrolyte surface area per unit cell volume and each brought their own advantages and disadvantages. 11 refs., 61 figs., 19 tabs.

14671 (LBL–29829) **Solid polymer electrolytes for rechargeable batteries: Final report.** Narang, S.C.; Macdonald, D.D. SRI International, Menlo Park, CA (USA). Nov 1990. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010231. Source: OSTI; NTIS; GPO Dep.

SRI International has synthesized novel solid polymer electrolytes for high energy density, rechargeable lithium batteries. We have systematically replaced the oxygens in PEO with sulfur to reduce the strong hard-acid hard-base interaction, while retaining the favorable helical conformation of the polymer backbone. The best polymer electrolyte produced so far is suitable for a medium power battery. In another effort, we have synthesized single ion conducting polymer electrolytes based on polyethyleneimine, polyphosphazene, and polysiloxane backbones. The single ion conducting polymer electrolytes will allow greater depth of charge and discharge by preventing dc polarization. The best conductivity so far with single ion conductors is 1.0×10^{-3} Scm^{-1} at room temperature. Further optimization of electrical and mechanical properties will allow the use of these polymer electrolytes in the fabrication of rechargeable lithium batteries. 8 tabs.

14672 Cognition device for battery residual capacity. Toko, Yoshi. 30 Sep 1990. Filed date 30 Oct 1989. Canada Patent patent application 2001776. 20p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

According to the invention, battery voltage information and battery ambient temperature information are input to a microprocessor through an analog-to-digital converter. In the microprocessor, the voltage information is corrected with load information. The data conforming to the ambient temperature information are read out of the battery discharge characteristic data which have been previously stored in memory. The readout data are compared with the corrected voltage information so that the battery residual capacity can be computed from the result of the above comparison data. In this arrangement, it is possible to recognize battery residual capacity accurately at an arbitrary point in time. 6 figs., 1 tab.

14673 Separator for alkaline cell and alkaline cell prepared by using this separator. Kosaka, Takemi; Sakamoto, Fukashi; Hidaka, Setsuo. 25 Sep 1990. Filed date 13 Feb 1990. Canada Patent patent application 2009933. 52p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A novel separator for an alkaline cell is provided, comprising a separator substrate and 0.1-10 wt % of amorphous ultrafine particles of titanium dioxide and/or hydrated titanium dioxide having a maximum primary particle diameter of 500 angstroms and a minimum specific surface area of 100 m^2/g. An alkaline cell which incorporates the above separator is also disclosed. The separator of the invention features an improved capability to retain electrolytic solution, improved resistivity against alkali, minimum storage of residual gas during charge, minimal electrical resistance, improved resistance to oxidation, and the capability to prevent dendrite formation. The invention is applicable both to secondary cells such as Ni-Cd or Ni-Zn types and to primary cells such as alkaline-manganese types. Experiments are described to illustrate the invention. 6 figs., 6 tabs.

14674 Lead-acid battery with a high low-temperature discharge current. Salamon, K. 18 Sep 1990. Germany, F.R. Patent priority P39036561;CA patent application 2009469. 12p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A lead-acid battery capable of delivering high low-temperature discharge current for a long operating time is disclosed. The low-temperature performance of the battery is enhanced by supplying its positive electrode with a lignin-containing repository substance, from which an expander is liberated by oxidative decomposition during formation and cyclical operation of the battery. This invention makes it possible to produce a negative electrode material without the addition of any expander. Suitable repository substances include plant materials such as straw, peat moss, and wood. Sawdust is particularly preferred for this purpose. The proportion of sawdust in the active mass of the positive electrode is preferably between 1 and 3 g per kg of lead powder. A relatively wide range of particle sizes of the sawdust, preferably in the 0.01 to 1.5 mm range, ensures that the oxidative decomposition of the wood in the accumulator acid takes place over a long operating time such that the negative electrode is supplied continuously with expander, but never beyond the requirement at a particular time. It is an advantage if an expander is also mixed directly into the negative electrode paste, but only in an amount of 0.01 to 0.15%. The performance of a lead-acid battery according to this invention, in particular a starter battery, is improved in several respects: the cold-start performance remains constant throughout operating time, and block-type formation is made simpler.

14675 Lithium anode rechargeable electrochemical generator. Lecerf, A.; Lubin, F.; Broussely, M. 15 Sep 1990. Filed date 8 Mar 1990. Canada Patent patent application 2011773. 29p. (In French). Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A rechargeable electrochemical generator is provided in which the anode is based on lithium of a lithium alloy and the electrolyte consists of a solution of a lithium salt in a non-aqueous solvent. The cathode material is a manganese dioxide containing lithium ions and presenting a crystallographic structure of α-MnO_2 called cryptomelane. The Li/Mn atomic ratio is preferably between 0.1 and 0.5. The electrolyte solvent is chosen from among lineary or cyclic ethers, esters, or their mixtures. The lithium salt dissolved in the solvent is chosen from among $LiAsF_6$, $LiCF_3SO_3$, $LiBF_4$, $LiPF_6$, $LiClO_4$ and their mixtures. The preferred electrolyte is a solution of $LiAsF_6$ in a mixture of propylene carbonate, ethylene carbonate, and dimethoxyethane. A method of fabrication of the cathodic material is also disclosed, consisting of heating a mixture of α-MnO_2 and a lithium compound to a temperature between 300 and 400°C, the preferred Li/Mn molar ratio being 0.5. The lithium compound can be chosen from among LiOH, Li_2O, Li_2CO_3, LiI, and LiBr. The heating causes a reaction between the manganese oxide phase and the lithium compound, and after the reaction, the product is washed in water to eliminate any excess unreacted lithium compounds. Experiments are described to illustrate the invention. 15 figs., 1 tab.

14676 Solid electrolyte tube for sodium sulfur cells and surface finishing process thereof. Ohshima, Masaaki; Kobayashi, Akira; Atsumi, Senji; Shimada, Hiromi. 31 Jul 1990. Filed date 18 Dec 1989. Canada Patent patent application 2005899. 23p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A solid electrolyte tube for a sodium-sulfur cell is provided, the tube having improved durability and reliability. A surface finishing process for producing such a tube is also disclosed. The tube of the invention has an outer surface of a roughness defined by an arithmetical mean deviation of the profile not exceeding 2.0 μm and a maximum height of the profile not exceeding 15 μm. The smooth and even nature of the surface means that local concentrations of Na ions, S, and sodium polysulfides are avoided, and thermal stresses are minimized. The process of the invention comprises leveling the outer surface of the tube in a certain stage of its production using a finishing apparatus or device so that the above-defined surface smoothness is achieved. The leveling can be carried out after molding and before bisque-firing, after bisque-firing and before final firing, or after the final firing. The finishing apparatus may be an apparatus incorporating a grinding mechanism. The invention also provides a process for making the electrolyte tube,

comprising molding a powder containing α-alumina, bisque-firing the green body, and final firing the body to convert the α-alumina into polycrystalline β''-alumina. Experiments are described to illustrate the invention. 6 figs., 1 tab.

29 ENERGY PLANNING AND POLICY

2901 Energy Analysis and Modeling

Refer also to citation(s) 14701, 14720, 15984

14677 (NEI-DK–501) **Cardinal planning of measuring programmes for marine wind turbine arrays.** Bjerregaard, E.T.D. Dansk Teknisk Oplysningstjeneste, Copenhagen (Denmark). Nov 1990 87p. (In Danish). Contract ENS-UVE-90.0049. Order Number DE91763399. Source: OSTI; NTIS (US Sales Only).

In connection with the erection of marine wind turbine arrays in Denmark it is important to ensure that all significant data is documented. The aim was to develope a cardinal plan for the establishment and carrying out of measuring programmes in relation to marine turbine arrays. Such a plan should ensure that future measurements have a common basis and at the same time serve as a catalogue for decision-making and prioritization with regard to the following more detailed working procedures and actual measuring programmes. The realization of two actual, completed, Danish marine wind turbine array projects are described in detail, and the principles of the suggested cardinal plan are explained in relation to the associated general demands and problems. (AB).

14678 (SVF–382) **Integrated energy and environmental analysis using computer based models.** Goertz, S. (Sydkraft AB, Malmoe (SE)); Gustafsson, B. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Nov 1990. 53p. (In Swedish). Order Number DE91763533. Source: OSTI; NTIS (US Sales Only).

The purpose of the study is to map out computeraided models, available today and in the future, for simulations of integrated energy systems. Six models with different degree of availability have been found to be central. These models are described in the report, which is written in Swedish. A great deal of work has been put into the description of the structure of computeraided models in general and models for simulating the energy systems in particular. It is important to understand how the results are being calculated by the models in order to evaluate the received information in the right way. In the last chapter several questions are being discussed such as: accessibility, limitations and possibilities of the models as well as their future application within the energy sector. These models are to be of great importance in integrated energy and environmental studies, both nationally, regionally and locally. (authors).

2902 Economics and Sociology

Refer also to citation(s) 14318, 14725, 14737, 14783, 14814

14679 (DOE/PR–0006) **Department of Energy Annual Procurement and Financial Assistance Report: FY 1990.** USDOE Office of Procurement, Assistance and Program Management, Washington, DC (USA). [1990]. 49p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009746. Source: OSTI; NTIS; GPO Dep.

The procurement and financial assistance activity of the Department of Energy (DOE) is summarized. DOE is generally not a consumer of the technology it develops, nor does it procure production quantities of hardware for its own use. DOE is involved in basic and applied research in a wide range of technology areas including the following: Nuclear energy, nuclear waste management, fossil energy, conservation, renewable energy, and nuclear weapons development. The DOE procurement activities also support national security in the production and testing of nuclear weapons and the management of the Strategic Petroleum Reserve and the Naval Petroleum and Oil Shale Reserves. With the exception of the national security activities and departmental administration. DOE spends its procurement dollars more as a catalyst for technology development than for acquiring goods and services for Federal use. DOE enters into contractual arrangements with large and small firms involved in the technology areas for which it is responsible. In addition, DOE is involved in contractual and financial assistance activities with educational institutions, nonprofit organizations, and State and local governments. A significant portion of DOE's mission is carried out by contractors operating DOE-owned plants and laboratories. Consequently, a large portion of DOE's procurement obligations is directed toward the funding of such management and operating contracts. For example, management and operating contractors operate nine major, multi-program Rational Laboratories located throughout the United States. DOE offers substantial opportunities for small and small disadvantaged business enterprises, both as DOE prime contractors and as subcontractors to the management and operating contractors. Each year, a portion of DOE's prime and subcontract awards is designated for small and small disadvantaged firms. (JF)

14680 (HY/FL-JULK–5) **Energy, ethics and politics: an evaluation of current reserch.** Rossilahdi, H. Helsinki Univ. (Finland). Dept. of Philosophy. 1989. 108p. (In Finnish). KTM-136/881/87. Order Number DE91763432. Source: OSTI; NTIS (US Sales Only).

The purpose of this study is to examine and assess Finnish energy policies, and to evaluate current social scientific research related to energy policies, from a philosophical and ethical viewpoint. The method of applied philosophical ethics is briefly introduced and different approaches to the issue are scrutinized and compared against the background set by the official national goals for energy policies. Although the goals of energy policies are not always explicitly studied in current research, the approaches can nevertheless be devided into two according to general attitudes towards them. Firstly, there is the 'official' line of research, which takes it more or less for granted that the consumption of energy will and must increase, but that, at the same time, something ought to be done about the accumulating environmental problems. In this line, future models, people's attitudes and the relationship of individual lifestyles to the larger scheme of energy consumption are standardly studied. Secondly, there are the alternative approaches, which often focus on the incomplete workings of democracy in theory as well as in practice. It is concluded that neither one nor the other of the approaches currently in use actually touch the deep ethical problems implicit already in the goals of national energy policies. Toward the end of the study, a contractual model is introduced which might offer an alternative approach to examining and assessing energy policies and related academic research.

14681 (INIS-mf–12806, pp. 11-14) **Pacific Basin economic and energy prospects in a global context.** Takahashi, H. (Institute of Energy Economics (Japan)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The author reviews the patterns of energy supply and consumption in the developed, newly industrialized, and developing countries of the Pacific Basin region. The area is a net importer of energy. The industrialized countries of this region are expected to continue their effort to decrease energy consumption, but in newly industrialized and developing countries energy consumption and economic growth are still linked. The economies of these countries also depend heavily on the global economy, which is in recession. As a result, a large increase in energy consumption in the area cannot be expected soon, but there will be a change in the energy supply structure. This change should include a shift towards nuclear power.

14682 (INIS-mf–12806, pp. 15-20) **Economic and energy prospects of Pacific Basin developed countries.** Empey, W.F. (Data Resources Canada Inc. (Canada)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The economic problems in the USA, Japan, Canada and Australia are the result of four imbalances: dependence on imported non-renewable energy, large government deficits, trade imbalances

and protectionism, and high unemployment. Markets and governments are the factors that will act through rising oil prices, high interest rates, restrictive fiscal policy, and a declining U.S. dollar exchange rate to correct these imbalances over the next ten years. There is a long-term opportunity for nuclear power to take over from oil as an energy source, although the high cost of capital will increase the price of nuclear electricity.

14683 (INIS-mf–12806, pp. 21-26) **Economic and energy prospects of Pacific Basin country: Korea.** Chon, W.Y. (Korea Electric Co., Seoul (Republic of Korea)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

As a rapidly developing country, the Republic of Korea will require more energy in the future in order to continue growing and achieve a technology-based industrial capacity. Until recently energy requirements have been met mostly with imported oil. Efforts are being made to develop a wide spectrum of alternative energy sources for the future. In the current Five-Year Economic and Social Development Plan, covering 1982-1986, Korea will increase territorial and overseas oil exploration, stockpile imported oil, and develop an energy plan based on nuclear power, coal, and natural gas. The utilization efficiency of energy will be improved. A more electricity-intensive economy will develop when the Republic of Korea joins the ranks of fully developed countries in the near future.

14684 (INIS-mf–12806, pp. 57-61) **1983 nuclear power outlook in Mexico.** Medina, M. (Comision Federal de Electricidad, Mexico City (Mexico)); Sarabia, E. Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

An economic crisis has forced Mexico to reduce drastically its development plans, including the programs for electricity generation. Electricity demand is forecast to be in the range of 250-300 TWH in the year 2000, about half of previous forecasts. Mexico depends more than 90 percent on oil for its energy requirements. There are programs to diversify energy sources, especially in the electricity sector. The country can use its oil, gas, hydro, geothermal, coal and uranium resources to generate electricity at commercial costs, and there are plans to develop them all intensively. However, the economic situation, particularly the enormous foreign debt, might force the country to rely more heavily on its domestic oil for some years. In the long term nuclear power is cheaper, but its capital cost combined with the fact that Mexico's first nuclear power project is very much delayed preclude the initiation of a new nuclear power project before the economy improves.

14685 (NEI-FI–130) **The price of energy as a factor influencing the investment decisions of industrial companies.** Eraeheimo, T. Liiketaloudellinen Tutkimuslaitos, Helsinki (Finland). 1988. 63p. (In Finnish). Order Number DE91763462. Source: OSTI; NTIS (US Sales Only).

The aim of this study was to determine the role of energy prices and availability in industrial investment decisions made in the 1980s. At the beginning of the study, the theoretical effects of the price of one production factor on investment are surveyed and some statistics illustrating the importance of energy during the period under study are presented. By interviewing decision-makers, fourteen investment projects important to energy consumption in Finland were surveyed to find out how energy prices, differences in prices between various forms of energy and expectations concerning them were taken into account in decision-making, and whether these factors affected the actual decisions. One of the projects analyzed was never carried out, but the other projects were implemented according to plan. Most of the report comprises analyses of these cases. During the last few years, energy has lost its special status in the planning processes of several companies. Generally speaking, prices for various forms of energy are expected to conform to the general price level. It was stressed several times that less expensive energy (compared with the beginning of the 1980s) would have lengthened the techno-economic life span of existing facilities and would also have eliminated some parts of the investments completed which were designed to save energy. Changes in absolute or relative prices after decision-making but before implementation had not, however, altered plans, even though the estimated profitability dropped below the target level. In cases like these, the assumed temporariness of the price change was cited as the explanation. Otherwise it seems that decision-making is based on daily prices. The effects of price changes on profitability are often simulated with sensitivity analyses.

2903 Environment, Health, and Safety

Refer also to citation(s) 14248, 14249, 14331, 14332, 14498, 14742, 15238, 15243

14686 (CONF-9011186–1) **Energy-related environmental issues in a global context.** Fri, R.W. Atlantic Council of the United States, Washington, DC (USA). [1990]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-89IE10763. From US/Japan energy policy dialogue; Washington, DC (USA); 8 Nov 1990. Order Number DE91009538. Source: OSTI; NTIS; GPO Dep.

Few subjects have received more attention in the past few years than the tension between energy and the environment. The fundamental issue behind this tension is how to provide required energy series in a sustainable way. This issue stretches beyond a global agenda to an intergenerational one. An agenda this expansive cannot be addressed by business-as-usual means, but requires us to think more fundamentally about the conditions that must exist in the future to deal successfully with this agenda, and how we can bring these conditions about. First, it's self-evident that we should invest heavily in research and development. The New Earth 21 proposal from Japan is a good example of this sort of program, as is Energy Technology R&D: What Could Make A Difference?, by Oak Ridge National Laboratory. Next, we must invest as heavily in science as technology. In particular, science should focus on reducing uncertainty about risks, for uncertainty can make us unnecessarily risk averse. Only greater scientific understanding can tell us if this risk aversion is misplaced. The final two conditions are institutional in nature. One is that we must find a way to build demand for both energy services and environmental protection. This is a special challenge in developing countries, because most of the energy growth and environmental problems of the future will be there. Lastly, global interdependence means sharing scare resources. The developed and developing worlds depend on one another, both economically and environmentally. We must face the issue of transferring financial and technology resources from the wealthy to the poor, even at some expense to the former. Technology, science, demand creation and resource transfers are large and general ideas. But if we don't attend to these large issues, the future tensions between basic needs for energy and the environment will become unbearable.

14687 (DOE/EH–002/0191/CERCLA) **Complying with Land Disposal Restrictions (LDR) for CERCLA remedial actions involving contaminated soil and debris: CERCLA Information Brief.** Bascietto, J. USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (USA). Office of Environmental Guidance. Jan 1991. 2p. Sponsored by USDOE, Washington, DC (USA). Source: INIS; OSTI (Free of Charge).

CERCLA Sect. 121(e) requires that remedial actions must comply with at least the minimum standards of all "applicable or relevant and appropriate requirements" (ARARs) of federal and state laws. EPA has determined that RCRA land disposal restrictions may be ARAR for certain CERCLA remedial actions involving soil and debris. This means that soil and debris contaminated with prohibited or restricted wastes cannot be land disposed if (1) these wastes have not attained the treatment standards set by EPA for a specified waste or (2) have been the subject of a case-by-case extension, national capacity variance, or successful "no migration" petition. RCRA LDR treatment standards are based on "Best Demonstrated Available Technology" (BDAT), not on health-based concentrations. Because the treatment of the soil and debris matrix presents technological difficulties not yet addressed by EPA (BDAT

standards are generally set for industrial process wastes), compliance options such as obtaining a Treatability Variance, are available and will generally be necessary for soil and debris wastes. In the recently promulgated revisions to the National Contingency Plan (NCP) for CERCLA implementation, EPA provides important information for CERCLA project managers regarding LDR compliance, particularly for obtaining a treatability variance for land disposal of contaminated soil and debris.

14688 (DOE/EH–002/0191-RCRA) **The small-scale treatability study sample exemption: RCRA Information Brief.** Coalgate, J. USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (USA). Office of Environmental Guidance. Jan 1991. 2p. Sponsored by USDOE, Washington, DC (USA). Source: INIS; OSTI (Free of Charge).

In 1981, the Environmental Protection Agency (EPA) issued an interim final rule that conditionally exempted "waste samples collected solely for the purpose of monitoring or testing to determine their characteristics or composition" from RCRA Subtitle C hazardous waste regulations. This exemption [40 CFR 261.4(d)] applies to the transportation of samples between the generator and testing laboratory, temporary storage of samples at the laboratory prior to and following testing, and storage at a laboratory for specific purposes such as an enforcement action. However, the exclusion did not include large-scale samples used in treatability studies or other testing at pilot plants or other experimental facilities. As a result of comments received by the EPA subsequent to the issuance of the interim final rule, the EPA reopened the comment period on the interim final rule on September 18, 1987, and specifically requested comments on whether or not the sample exclusion should be expanded to include waste samples used in small-scale treatability studies. Almost all responders commented favorably on such a proposal. As a result, the EPA issued a final rule (53 FR 27290, July 19, 1988) conditionally exempting waste samples used in small-scale treatability studies from full regulation under Subtitle C of RCRA. The question of whether or not to extend the exclusion to larger scale as proposed by the Hazardous Waste Treatment Council was deferred until a later date. This information Brief summarizes the requirements of the small-scale treatability exemption.

14689 (DOE/EH–231-001/0490) **Reporting releases of hazardous substances under CERCLA and EPCRA: CERCLA Information Brief.** Dailey, R. USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (USA). Environmental Guidance Div. Apr 1990. 2p. Sponsored by USDOE, Washington, DC (USA). Source: INIS; OSTI (Free of Charge).

Several federal environmental laws requires that "release of hazardous substances to the environment" above certain threshold amounts – Reportable Quantities or RQs – be reported. Current and proposed regulations under these statutes are unclear and make full compliance difficult. Nevertheless, failure to comply could result in civil or criminal penalties. In response to questions raised by several DOE Field Elements, this Information Brief is part of a series that will provide updated information on this and other CERCLA issues. The Environmental Guidance Division (EH-231) has responded to those questions relating the reporting of releases for which EPA has a clearly articulated position. EPA's position on other questions raised by Field Elements has been equivocal; DOE is working with EPA to resolve these outstanding issues. Additional information briefs on reporting releases will be issued as a clear position is defined.

14690 (DOE/EH–231-001/0990) **Requirements for the recycling of hazardous waste: RCRA Information Brief.** Petts, M. USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (USA). Office of Environmental Guidance. Sep 1990. 2p. Sponsored by USDOE, Washington, DC (USA). Source: INIS; OSTI (Free of Charge).

The regulatory status of materials destined to be recycled is not always clear. There have been numerous questions from DOE Field Elements regarding the applicability of the Resource Conservation and Recovery Act (RCRA) to certain materials that can be recycled. The Office of Environmental Guidance, RCRA/CERCLA Division, has responded to questions relating to the RCRA regulations as they apply to materials that are recycled or are destined for recycling. Additional regulatory requirements for these materials may be promulgated upon the reauthorization of RCRA (e.g., regulation of used oil). Additional EH-23 information Briefs will be issued as these regulations develop. The Office of Environment, Safety and Health has convened a workshop to establish DOE's position on a number of issues associated with mixed waste and materials management, several relative to recycling.

14691 (DOE/EH–231-001/1190) **PCB manifesting, tracking and disposal requirements: TSCA Information Brief.** Schumann, J. USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (USA). Office of Environmental Guidance. Nov 1990. 2p. Sponsored by USDOE, Washington, DC (USA). Source: OSTI (Free of Charge).

The Environmental Protection Agency (EPA) published a Federal Register notice on December 21, 1989, which established requirements for all facilities generating polychlorinated biphenyl (PCB) waste to track the disposal process in a manner similar to the "cradle-to-grave" system of the Resource Conservation and Recovery Act (RCRA). The final rule became effective on February 5, 1990. As part of the EH-231 response to the final rule, a series of questions were posed to the EPA requesting clarification on the impact of the rule to Department of Energy (DOE) facilities storing PCB waste. This information Brief will review the final rule and the EPA response to the request for clarification.

14692 (DOE/EH–231-003/0191) **"Hazardous" terminology: CERCLA Information Brief.** Powers, J. USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (USA). Office of Environmental Guidance. Jan 1991. 2p. Sponsored by USDOE, Washington, DC (USA). Source: INIS; OSTI (Free of Charge).

A number of terms (e.g., "hazardous chemicals," "hazardous materials," "hazardous waste," and similar nomenclature) refer to substances that are subject to regulation under one or more federal environmental laws. State laws and regulations also provide additional, similar, or identical terminology that may be confused with the federally defined terms. Many of these terms appear synonymous, and it easy to use them interchangeably. However, in a regulatory context, inappropriate use of narrowly defined terms can lead to confusion about the substances referred to, the statutory provisions that apply, and the regulatory requirements for compliance under the applicable federal statutes. This information Brief provides regulatory definitions, a brief discussion of compliance requirements, and references for the precise terminology that should be used when referring to "hazardous" substances regulated under federal environmental laws. A companion CERCLA Information Brief (EH-231-004/0191) addresses "toxic" nomenclature.

14693 (DOE/EH–231-004/0191) **"Toxic" terminology: CERCLA Information Brief.** Powers, J. USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (USA). Office of Environmental Guidance. Jan 1991. 2p. Sponsored by USDOE, Washington, DC (USA). Source: INIS; OSTI (Free of Charge).

A number of terms (e.g., "toxic chemicals," "toxic pollutants," toxic waste," and similar nomenclature) refer to substances that are subject to regulation under one or more federal environmental laws. State laws and regulations also provide additional, similar, or identical terminology that may be confused with the federally defined terms. Many of these terms appear synonymous, and it is easy to use them interchangeably. However, in a regulatory context, inappropriate use of narrowly defined terms can lead to confusion about the substances referred to, the statutory provisions that may apply, and the regulatory requirements for compliance under the applicable federal statues. This information Brief provides regulatory definitions, a brief discussion of compliance requirements, and reference for the precise terminology that should be used when referring to "toxic" substances regulated under federal environmental laws. A companion CERCLA Information Brief (EH-231-003/0191) addresses "hazardous" nomenclature.

14694 (DOE/IG–0294) **Environmental training at the Department of Energy.** USDOE Office of Inspector General, Washington, DC (USA). Capital Regional Audit Office. 21 Dec 1990. 13p. Sponsored by USDOE, Washington, DC (USA). Source: OSTI (Free of Charge).

Report to The Secretary.

This report concerns environmental training issues raised in the Office of Inspector General Flash Report, "Compliance with the Resource Conservation and Recovery Act and Other Environmental Requirements" (CR-F-89-1), dated July 14, 1989. The purpose of our audit was to determine whether the Department of Energy (DOE) has ensured that: DOE and contractor managers are aware of their responsibilities and potential liabilities under applicable environmental regulations; and Individuals engaged in hazardous waste operations have received the required environmental training.

14695 (ETDE-mf–1764632) **Public participation in waste management projects. Analyses and evaluation of conflicts and strategies for solutions.** Arbeiten zur Risiko-Kommunikation. Wiedemann, P.M.; Femers, S.; Hennen, L. Forschungszentrum Juelich GmbH (Germany, F.R.). Programmgruppe Mensch, Umwelt, Technik (MUT). Nov 1990 170p. (In German). Order Number DE91764632. Source: OSTI; NTIS (US Sales Only).

The project attempts to asses participatory forms of decision-making on technology and location for waste disposal: The central question in this context relate to the problems and opportunities of people participation. Initial research concentrated on conflicts connected with waste disposal technologies, conflict perception of the persons involved and their conflict strategies. Four cases were identified which were seen as innovative methods of conflict management by the persons involved. Based on these cases one developed a model for the 'implementation of the cooperation principle in controversies relating to waste disposal plants' whose main components are: - A mediating instance which has expert knowledge and is non-partisan, - a decision-making aid for setting up assessment criteria for the various options and the structuring of the problem to be decided upon - a team of experts who will analyse the consequences. The process of joint decision-making can be broken down into six phases: Structuring of the problem, external support in working on the problem, working on the problem, external support of decision-making, advice and internal decision-making, decision-making and implementation. (orig./HSCH).

14696 (NEI-DK–496) **Environmental planning in the Nordic countries: Speech at the NIM conference.** Larsen, I. Miljoekontrollen, Copenhagen (Denmark). 1990 17p. (CONF-9006332–1: Conference on environmental planning in the Nordic countries, Stockholm (Sweden), 6-8 Jun 1990). Order Number DE91763365. Source: OSTI; NTIS (US Sales Only).

A speech given at the (NIM) Nordiska industrifoerbundens Miljoevaardskommitten (Nordic Industrial Alliance Committee for Environmental Protection) conference in June, 1990 where the speaker attempts to present a picture of how environmental planning in the Nordic countries is being carried out and how it has developed over the past twenty years. The environmental policies of some individual Nordic countries and some actions taken to reduce pollution are briefly described in relation to emission control, waste management and pollution of the air and the sea. Tables which, amongst other subjects, illustrate the number of units submitted to supervision by municipalities in Denmark, nitrogen fallout in the Baltic and North Sea, carbon dioxide emission per thermic and electrical energy unit and combustion value in relation to waste, natural gas, oil, coals and peat are presented. (AB).

14697 (PNL–7642) **Compilation of lessons learned from the analysis of Superfund.** Siegel, M.R.; Powell, J.A.; Abrams, C.W. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009731. Source: OSTI; NTIS; GPO Dep.

The US Department of Energy (DOE) is in the initial stages of its complex-wide environmental restoration program. This environmental restoration program is being conducted primarily under the statutory authorities of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the corrective action provisions of the Resource Conservation and Recovery Act (RCRA). Environmental restoration at DOE facilities is expected to be a multi-billion dollar effort extending over the next 20–50 years. DOE must take necessary steps, as required by federal and state statutes and regulations, to protect human health and the environment at those facilities and operations under its purview. DOE is obligated to carry out this mission in the most effective and cost-effective manner possible, while still meeting or exceeding applicable regulatory requirements. The US Environmental Protection Agency (EPA) is the agency primarily responsible for administering CERCLA. EPA's implementation of the Superfund program has come under considerable scrutiny and criticism over its 10-year history. Many external groups have reviewed EPA's Superfund program, identified shortcomings or deficiencies, and made numerous recommendations for its improvements. The groups reviewing EPA's Superfund program include the Office of Technology Assessment (OTA), the General Accounting Office (GAO), and business and environmental organizations. The purpose of this report is to identify the issues cited by these groups that are most relevant to DOE's environmental restoration program and to discuss the implications of the studies' findings for DOE. The findings of these groups are presented because they are representative of the areas where DOE will be scrutinized in the future. DOE does not necessarily agree with the findings and conclusions of these studies. 16 refs., 1 tab.

14698 (PNL–7647) **Sage grouse on the Yakima Training Center: A summary of studies conducted during 1989 and 1990.** Eberhardt, L.E. (Pacific Northwest Lab., Richland, WA (USA)); Hofmann, L.A. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 70p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91010014. Source: OSTI; NTIS; GPO Dep.

A two-year study, sponsored by the U.S. Department of the Army and conducted by Pacific Northwest Laboratory, was initiated in 1989 to study sage grouse on the Yakima Training Center (YTC). The specific objectives of this study were (1) to obtain detailed information on the distribution and relative density of sage grouse on the YTC, (2) to identify movement and habitat use patterns of sage grouse on the YTC, (3) to identify crucial habitat for sage grouse on the YTC, and (4) to provide management recommendations. Sage grouse were selected for study because they are a US Fish and Wildlife Service candidate species for the threatened and endangered list in Washington, and because the YTC probably contains the largest population of sage grouse left on federally owned lands in this state. The locations of 11 sage grouse leks, or breeding grounds, were determined on the YTC during extensive spring helicopter surveys. The maximum number of sage grouse observed during ground surveys of these leks varied from 2 to 55 birds. One lek, located near Range 19, was probably used by 40 to 50% of the YTC sage grouse population. Fifteen years of counts of males on leks indicate that the YTC sage grouse population was most numerous during the early to mid 1980s. Since the mid-1980s, sage grouse numbers appear to have declined on the YTC and in other locations in Washington. Forty-six sage grouse (17 females and 29 males) were captured and fitted with radio transmitters during 1989 and 1990. Movements by these sage grouse were both erratic and large when compared with other studies. We believe that many of the atypical movements were in response to military training activities. Sage grouse appeared to seek out areas on the YTC where human disturbance was low. Recommendations are made for improving the management of grouse habitat.

14699 (SAND–90-2838C) **Reduction of solvent use through fluxless soldering.** Hosking, F.M. Sandia National Labs., Albuquerque, NM (USA). [1990]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-901285–1: USAF/DOE workshop on solvent substitution, Phoenix, AZ (USA), Dec 1990). Order Number DE91009888. Source: OSTI; NTIS; GPO Dep.

Conventional soldering typically requires fluxing to promote wetting. Halogenated solvents must then be used to remove the flux residues. While such practice has been routinely accepted throughout the DOE weapons complex, new environmental laws and agreements will eventually phaseout the use of these solvents. Solvent substitution or alternative technologies must be developed to meet these restrictions. SNL, Albuquerque is characterizing and developing alternative fluxless soldering technologies that will reduce solvent use and be compatible with prototypic packaging materials. The program is focusing on controlled atmosphere (vacuum, inert/reducing gas, reactive plasma, and activated acid vapor)

soldering, metallization and inhibitor technology, and thermomechanical surface activation (laser, infrared, solid state diffusion, and ultrasonic) soldering. Since there is no universal method that can be applied to every electronic application, the study is defining technological options and limitations. Fluxless soldering would reduce the number of cleaning steps and the subsequent volume of mixed solvent waste. This paper will present an overview of the effects of atmosphere, materials, and processing conditions on attaining a fluxless operation. Examples of applying these technologies to electronic packaging are given.

14700 (SNV–3750) **Light vehicles and cleaner air: More stringent emission requirements.** National Environmental Protection Agency, Solna (Sweden). Jun 1990. 74p. Order Number DE91763538. Source: OSTI; NTIS (US Sales Only).

There are means available to further lower exhaust and evaporative emissions from passenger cars and light-duty trucks. Emission requirements may consequently be made more stringent. This could be done by relating to developments in the USA. More stringent requirements are decided in California. The rest of USA is expected to do the same. Road vehicles contribute to a large extent to the air pollution of for example, nitrogen oxides, hydrocarbons and carbon monoxide. Even a large fraction of carbon dioxide emissions comes from traffic. More stringent requirements along the lines presented entail lower nitrogen oxides and hydrocarbons emissions. The proposal by the Swedish Environmental Protection Agency upon new exhaust and evaporative emission requirements is presented along with an overview of the consequences for the environment, cost, trade policy, the integration in Western Europe etc. Information is supplied upon emission control technology and rules and regulations. The proposal on emission requirements for light vehicles is one of several in the traffic-area put forward by the Agency. All are summarized in Air-90 action program against air pollution and acidification.

2904 Energy Resources

Refer also to citation(s) 14683, 14686, 14713

14701 (SR/NES–90-01) **Improving technology: Modeling energy futures for the National Energy Strategy.** USDOE Energy Information Administration, Washington, DC (USA). 17 Jan 1991. 144p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009199. Source: OSTI; NTIS; GPO; GPO Dep.

This report was prepared as a contribution to the formulation of the National Energy Strategy. It is an attempt to examine how commercializing and deploying known technologies might affect America's energy future. In order to do this, it was necessary to create a baseline projection of extending for 40 years, to 2030. The baseline case was then modified by about a dozen excursions. These excursions tested what would happen if particular technological or regulatory assumptions were varied: for example, if new nuclear orders and life extension of existing plants were permitted, or if improved end-use energy technologies began to filter into the capital stock. Finally, relevant groups of excursions were grouped into scenarios in an effort to see how close they could get the U.S. energy system to achieving certain possible policy objectives: reducing carbon emissions; reducing vulnerability to foreign oil sources; and reducing energy costs. This report is not intended to be construed as an actual forecast of future events. Rather, the baseline case is designed to provide perspective on how the nation's energy system might evolve if no new energy policies, laws, or regulations were adopted over the projection horizon and if the tendencies of the U.S. energy system evident today were to persist. Given the long-term nature of this report, its conclusions would have been little altered if a brief post-Kuwait invasion oil price spike had been incorporated into the projections. A limited set of energy technology and regulatory issues are examined. In the long run, technological change is one of the most important sources of economic growth. The report estimates the impact of a number of frequently discussed technologies on U.S. energy production, consumption, and prices. Most technologies considered have been demonstrated in a laboratory setting or reduced to practice, though many have not yet been adopted for commercial use. 42 refs., 56 figs., 38 tabs. (JF)

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 14045, 14093, 14126, 14127, 14128, 14434, 14436, 14443, 14454, 14686, 14701, 14731, 14746, 14747, 14754, 14755, 14756, 14815, 14819, 14821, 14823, 14852

14702 (DOE/CE–0300P) **Twelfth annual report to Congress on the Automotive Technology Development Program: Annex No. 2.** USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Advanced Propulsion Div. Nov 1990. 49p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91008995. Source: OSTI; NTIS; GPO Dep.

This is the twelfth annual report on the progress in implementing the Automotive Propulsion Research and Development Act of 1978. The Act provides for an expanded R&D effort with respect to advanced automotive propulsion systems technology which would complement and stimulate corresponding efforts by the private sector. Develop proof-of-concept advanced automotive heat engines and demonstrate the capability, relative to current spark ignition (SI) engines, for (1) a 30 percent or greater improvement in vehicle fuel economy; (2) meeting emissions, safety, and noise standards; (3) projected competitive initial and life cycle costs; and (4) alternative fuels utilization capabilities. Develop advanced heavy-duty diesel engine technology capable of producing a 30 percent improvement in vehicle fuel economy, relative to 1982 technology, while meeting or exceeding the EPA emissions regulations. Establish a structural ceramics and advanced materials technology base in support of advanced heat engine development. Establish a technology base for the use of alternative fuels in advanced and contemporary heat engines. Find a replacement for the CFC-12 chlorofluorocarbon currently used in automotive air conditioner units. In summary, the R&D projects in progress address the high-risk areas associated with the development of ceramic components for the gas turbine engine, heavy duty adiabatic diesel engine technology, advanced materials technology, and alternative fuels utilization technology, and replacing the automotive CFC-12 air conditioning fluid. 8 figs., 1 tab.

14703 (LBL–28737-Rev.) **Energy Conversion and Storage Program: Annual report, 1989.** Lawrence Berkeley Lab., CA (USA). Dec 1990. 31p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010221. Source: OSTI; NTIS; GPO Dep.

The Energy Conversion and Storage Program applies chemical and chemical engineering principles to solve problems in (1) production of new synthetic fuels; (2) development of high-performance rechargeable batteries and fuel cells; (3) development of advanced thermochemical processes for energy storage; (4) characterization of complex chemical processes; and (5) the application of novel materials for energy conversion and transmission. Projects focus on transport-process principles, chemical kinetics, thermodynamics, separation processes, organic and physical chemistry, and advanced methods of analysis. The report is divided into the following five sections: electrochemical energy storage and conversion; microstructured materials; biotechnology; fossil fuels; and high-temperature superconducting processing. Papers have been processed separately for inclusion on the data base.

14704 (NEI-DK–499, pp. 1-25) **The Danish Energy Agency: Experience, expectations and potentials.** Jensen, K.P. (Energistyrelsen (DK)). Dansk Automationsselskab, Lyngby (Denmark). 1990. 157p. (In Danish). (CONF-9002180–: Conference on decentral cogeneration plants and industrial heat and power production, Lyngby (Denmark), 28 Feb 1990). In *Decentral cogeneration plants and industrial heat and power production.* Order Number DE91763388. Source: OSTI; NTIS (US Sales Only).

The paper presented by a representative of the Danish Energy Agency lists implemented projects in the form of decentral and larger dual-purpose power plants in Denmark that are authorized by the agency. Plans for development and demonstration programs are illuminated. It is emphasized that Danish technology should be utilized and that consideration must be taken for the protection of the environment. (AB).

14705 (ORNL–6600) **Technology innovation and management in the US Bureau of the Census: Discussion and recommendations.** Tonn, B.; Edwards, R.; Goeltz, R.: Hake, K. Oak Ridge National Lab., TN (USA). Sep 1990. 79p. Sponsored by Department of Commerce, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91000542. Source: OSTI; NTIS; GPO Dep.

This report contains a set of recommendations prepared by Oak Ridge National Laboratory (ORNL) for the US Bureau of the Census pertaining to technology innovation and management. Technology has the potential to benefit the Bureau's data collection, capture, processing, and analysis activities. The entire Bureau was represented from Decennial Census to Economic Programs and various levels of Bureau management and numerous experts in technology. Throughout the Bureau, workstations, minicomputers, and microcomputers have found their place along side the Bureau's mainframes. The Bureau's new computer file structure called the Topologically Integrated Geographic Encoding and Referencing data base (TIGER) represents a major innovation in geographic information systems and impressive progress has been made with Computer Assisted Telephone Interviewing (CATI). Other innovations, such as SPRING, which aims to provide Bureau demographic analysts with the capability of interactive data analysis on minicomputers, are in the initial stages of development. Recommendations fall into five independent, but mutually beneficial categories. (1) The ADP Steering Committee be disbanded and replaced with The Technology Forum. (2) Establishment of a Technology Review Committee (TRC), to be composed of technology experts from outside the Bureau. (3) Designate technological gurus. These individuals will be the Bureau's experts in new and innovative technologies. (4) Adopt a technology innovation process. (5) Establish an Advanced Technology Studies Staff (ATSS) to promote technology transfer, obtain funding for technological innovation, manage innovation projects unable to find a home in other divisions, evaluate innovations that cut across Bureau organizational boundaries, and provide input into Bureau technology analyses. (JF)

14706 (RISO-M–2921) **Plan for the activities of Risoe National Laboratory of the three-year period 1991 to 1993.** Risoe National Lab., Roskilde (Denmark). Jan 1991. 36p. (In Danish). Order Number DE91763382. Source: OSTI; NTIS (US Sales Only).

The plan for the activities of Risoe National Laboratory of the three-year period 1991 to 1993 maintains the long-term research aimed at technological development in three main areas energy, environment and materials. In the three years period emphasis is put on 10 specific technical areas. (author).

2906 Nuclear Energy

Refer also to citation(s) 14544, 14545, 14546, 14547, 14548, 14549, 14550, 14551, 14552, 14553, 14554, 14555, 14556, 14559, 14560, 14561, 14562, 14681, 14682, 14684, 14724, 14736, 14742, 15371

14707 (INIS-mf–12806) **Proceedings of the fourth Pacific Basin nuclear conference.** Vogt, E.W. (TRIUMF, Vancouver, BC (Canada)); Ludgate, G.A. (eds.). Canadian Nuclear Association, Toronto, ON (Canada). 1983 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The 45 papers presented at this conference examined the status, future plans and significance of nuclear development for the Pacific Basin. Sessions covered the topics of energy and economics, nuclear power programs, the fuel cycle, waste management, seismic design, radionuclide production and use, and issues affecting nuclear goals.

14708 (INIS-mf–12806, pp. 36-40) **Nuclear power program in Indonesia: Status and prospects.** Subki, I.R. (National Atomic Energy Agency, Jakarta (Indonesia)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The nuclear program in Indonesia is derived from the long-range national development plan. The main aim of this plan is to realize a just and prosperous society within a united and democratic nation, and to contribute to world peace. A research and development infrastructure is being developed to establish the necessary technological foundations, to train technical personnel, and to develop the capacity for technical adaptation and innovation. BATAN, the National Atomic Energy Agency, is responsible for nuclear R and D, and also has a regulatory function and implements the national nuclear program. The author describes the functions of the eight BATAN laboratories, and surveys the energy resources available to Indonesia. In the ten years preceding 1983 electric energy consumption increased at a rate of 12.4 percent per year. It is projected that an electric capacity of 42,000 MW(e) will be required in the year 2003. The nuclear contribution could be around 10 percent. The decision to adopt nuclear power generation depends, among other factors, on financial considerations, the perception that nuclear power would perpetuate the dependence on developed nations, and safety concerns.

14709 (INIS-mf–12806, pp. 52-56) **Nuclear power program in Korea: Status and prospects.** Sung, N.C. (Korea Heavy Industries and Construction Co. Ltd., Seoul (Republic of Korea)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Korea is a nation making great progress with its nuclear power development program despite the current worldwide nuclear industry slump resulting from the global recession. The reason for this is that Korea does not have sufficient energy resources to meet demand. Six 950 MW nuclear power plants are under construction, and these units are scheduled for completion by 1989. This paper describes the status of Korea's nuclear power development program and the activities of local nuclear industries. It also discusses the efforts being made by local industries to achieve self-reliance.

14710 (INIS-mf–12806, pp. 62-66) **Development of nuclear power and related topics in China.** Wang Ganchang (Chinese Nuclear Society, Beijing, BJ (China). Div. of Nuclear and Radiochemistry). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

During the early 80's China strengthened the whole range of its nuclear activities, ranging from prospecting and exploration for uranium minerals through uranium extraction, fuel manufacture, the development of equipment and instrumentation, to the construction and operation of nuclear power plants. Emphasis has been placed on self-reliance, although the transfer of advanced technology from foreign countries would be welcomed. This paper reviews the status of current nuclear power projects, discusses the development and application of radioisotope technologies, and reviews the nuclear energy research program.

14711 (INIS-mf–12806, pp. 72-83) **The nuclear power programs in the United States: Status and prospects.** Voigt, W.R. (USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The introduction of nuclear power into the energy infrastructure of the United States has been achieved with maximum safety and competitive economics. However, the growth of the nuclear industry has been less than early projections, due to the recession following the oil crisis of the 1970s and policies of the governments of that time. As the economy recovers, the government has taken some initiatives to encourage nuclear power. The lull in activity has been used to update the regulatory system, and the industry has

used the time to introduce higher standards for quality assurance and cost effectiveness. The United States is committed to nuclear power.

14712 (INIS-mf–12806, pp. 30-32) **Conference luncheon.** Rose, D.J. (Massachusetts Inst. of Tech., Cambridge, MA (USA)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The state of nuclear power and the electric power industry in the US and elsewhere is partly the fault of the electric utilities, which have not made clear the true benefits of electricity and have not devoted enough resources to the R and D necessary to build a viable industry.

14713 (INIS-mf–12806, pp. 359-361) **Grand banquet address of the honorable Mitchell Sharp.** Sharp, Mitchell (Northern Pipeline Agency (Canada)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The early 1980s are a time of relatively abundant energy. But shortages will occur again. This is the time to start developing new energy resources, including nuclear power.

14714 (INIS-mf–12806, pp. 363-366) **Constraints of nuclear power expansion in the Republic of Korea.** Lim, Y.K. (Atomic Energy Commission (Republic of Korea)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Korea has three nuclear power units in operation and 6 units under construction. Local industries are participating extensively in the construction of the latest units. By 1991 there will be 11 units operating with an installed capacity of 10 GWe. After 1991 one or two nuclear units will be required annually to meet electrical demand. In order to continue rapid nuclear development, issues in the fields of nuclear safety, efficiency improvement, codes and standards, capital investment, manpower, and completing the fuel cycle will have to be resolved. International cooperation can go a long way to resolving constraints on the growth of the nuclear industry in developing countries.

14715 (INIS-mf–12806, pp. 371-372) **Factors in the revitalization of nuclear energy in the U.S.** Zebroski, E.L. (Electric Power Research Inst., Palo Alto, CA (USA)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Nuclear energy continues to be a healthy growth industry in the United States in terms of the productivity and reliability of the capacity in operation, and the expected additions to capacity in operation during the 1980s. The total nuclear generation (until recently) has been greater than all the rest of the world combined, and will continue to be comparable, although less than that total, for the forseeable future. The preconditions for resumption of plant commitments involve a complex of public perception, regulatory and technical issues, most of which can be resolved by the early 1990s.

2908 Heat Utilization

Refer also to citation(s) 14124, 14125, 14387, 14389, 14390

14716 (NEI-DK–499) **Decentral cogeneration plants and industrial heat and power production.** Dansk Automationsselskab, Lyngby (Denmark). 1990 157p. (In Danish). (CONF-9002180–: Conference on decentral cogeneration plants and industrial heat and power production, Lyngby (Denmark), 28 Feb 1990). Order Number DE91763388. Source: OSTI; NTIS (US Sales Only).

Papers presented at a conference held at the Technical University of Denmark in February 1990 on Danish decentral cogeneration plants and industrial heat and power production. The papers covered a variety of aspects within this field, including technology, economy, policy and the influence on the larger Danish power companies of the government agreement of 1986 where it was decided to develope the establishment of decentral cogeneration plants using natural gas, straw and wastes as fuels. (AB).

14717 (NEI-DK–499, pp. 1-7) **Power plants: Experience, expectations and potentials.** Berge, K. (Elkraft A.m.b.A. (DK)). Dansk Automationsselskab, Lyngby (Denmark). 1990. 157p. (In Danish). (CONF-9002180–: Conference on decentral cogeneration plants and industrial heat and power production, Lyngby (Denmark), 28 Feb 1990). In *Decentral cogeneration plants and industrial heat and power production.* Order Number DE91763388. Source: OSTI; NTIS (US Sales Only).

In 1986 the Danish government made an agreement in connection with the development of national electric power production that the political accept of continued development of central coal-fired power plants was to be dependent on that decentral cogeneration plants should be built with a total electrical power effect of 450 MW achieved before the end of 1995. Responsibility for the power effect was divided between the two large Danish electricity sypply companies who were also responsible for the building programme. It was also decided that decentral cogeneration plants could be installated outside the regime of the electricity supply companies. The status and economy with regard to the carrying out of this agreement is briefly touched upon. (AB).

14718 (NEI-DK–499, pp. 1-10) **Heat and power production at I/S Amagerforbraending.** Lerski, L. (OC, Raadgivende Ingenioerer A/S (DK)). Dansk Automationsselskab, Lyngby (Denmark). 1990. 157p. (In Danish). (CONF-9002180–: Conference on decentral cogeneration plants and industrial heat and power production, Lyngby (Denmark), 28 Feb 1990). In *Decentral cogeneration plants and industrial heat and power production.* Order Number DE91763388. Source: OSTI; NTIS (US Sales Only).

Building plans, for the significant expansion and retrofitting of a large power plant in Amager, Denmark, for the incineration of municipal wastes from the Copenhagen, and surrounding, areas so that it can produce electric power and heating, - are explained in relation to production, economy and design. Diagrams and budget tables illustrate the text. (AB).

2910 Conservation

Refer also to citation(s) 14734, 14783, 14819, 14868

14719 (PNL–7652) **Energy-efficiency testing activities of the Mobile Energy Laboratory: Semiannual report, April 1, 1990–September 30, 1990.** Parker, G.B.; Currie, J.W. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 69p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009643. Source: OSTI; NTIS; GPO Dep.

This report summarizes energy-efficiency testing activities applying the Mobile Energy Laboratory (MEL) testing capabilities during the third and fourth quarters of fiscal year (FY) 1990. The MELs, developed by the US Department of Energy (DOE) Federal Energy Management Program (FEMP), are administered by Pacific Northwest Laboratory (PNL) and the Naval Energy and Environmental Support Activity (NEESA) for energy testing and energy conservation program support functions at federal facilities. MELs are equipped for the on-site evaluation of energy use efficiency. The using agencies principally fund MEL applications, while DOE/FEMP funds program administration and capability enhancement activities. This report fulfills the requirements established in Section 8 of the MEL Use Plan (PNL-6861) for semiannual reporting on energy-efficiency testing activities using the MEL capabilities. The MEL Use Committee, formally established in 1989, developed the MEL Use Plan and meets semiannually to establish priorities for energy-efficient testing applications using the MEL capabilities. This report

describes the testing, test results, and suggested courses of action.

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 14091, 14701

14720 (ECN-C–91-002) **The CPB energy demand projections examined: Comments on the energy demand in the CPB scenario Medium.** Tiemersma, D.N. Netherlands Energy Research Foundation, Petten (Netherlands). Jan 1991. 38p. (In Dutch). Order Number DE91760577. Source: OSTI; NTIS (US Sales Only).

First the development of the long-term CPB scenarios is described as well as the most important assumptions and characteristics of the scenario Medium. Special attention is paid to changes in economic variables and the energy demand, distinguished in fuels and electric power. Next the impact of these changes on the energy demand in the above-mentioned scenario is indicated. Apart from lower energy prices, conservation policies and environmental policies, the European integration, population prognosis and expectations with regard to the economic growth can have any impact on the energy demand. Comments are given on the CPB method to project energy demand scenarios. Subsequently the emissions of SO_2, NO_y and CO_2 for the year 2010 in the reference-scenario of the NEEV'88 study (NEEV stands for National Energy and Emission Outlook) are presented for the residential sector, the industrial sector, the transportation sector and other consumers. The same has been done for the NEV'87 study (National Energy Outlook). The emission data are confronted with the comments on the CPB scenarios. It appears that only a decrease in economic or industrial growth can keep the emissions under desired levels. 23 refs.

14721 (RISO-M–2920) **A technical-economic model for the industrial energy consumption and energy related CO_2, SO_2 and NO_x emissions: INDUS version 2. EMIS.** Moeller Andersen, F.; Kilde, N.A.; Nielsen, L.H.; Praestegaard, S. Risoe National Lab., Roskilde (Denmark). Systems Analysis. Jan 1991. 158p. (In Danish). Contract ENS-0351/89-1. Order Number DE91763381. Source: OSTI; NTIS (US Sales Only).

This report presents an updating and enlargement of the INDUS model described in the report "A technical-economic model for the industrial energy consumption in Denmark". Risoe National Laboratory, July 1986 (RISO-M-2606) (in Danish). In short the model is characterized as an econometric sub-model that converts ADAM-forecasts to forecasts for the industrial energy consumption. (ADAM is a macro-economic model used by the Danish Ministry of Finance). The model is reestimated on data for 1966 to 1985 and using the latest published energy balances, the post-sample properties of the model for 1986 and 1987 are analyzed. Using the same method of modelling as for the industrial branches the model is enlarged to include the primary and construction sectors. The primary sector is disaggregated into three branches: agriculture etc., horticulture, and fishing. Finally, a sub-model for the calculation of energy related CO_2, SO_2, and NO_x emissions is developed. This model is based on the energy balances of the Danish Statistical Office and technical determined emission coefficients for the individual fuels included in the energy balances. (editor).

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 14183, 14436, 14443, 14563, 14683, 14686, 14687, 14688, 14689, 14690, 14691, 14692, 14693, 14746

14722 (DOE/CR–0002-2/91) **United States Department of Energy posture statement and Fiscal Year 1992 budget overview.** Watkins, J.D. USDOE Office of the Secretary, Washington, DC (USA). Feb 1991. 113p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009066. Source: OSTI; NTIS; GPO Dep.

The crisis in the Persian Gulf also illustrates the need for long-term solutions to energy issues. Our nation faces many challenges in obtaining ample supplies of reasonably priced energy to fuel economic growth, while enhancing environmental quality. Although oil use in the US economy as a percentage of GNP has been substantially reduced over the last 30 years, the US, as the largest oil consumer in the world, remains vulnerable to international oil market disruptions. Moreover, US imports of oil are forecast to rise from 42 percent of domestic consumption in 1989 to 62 percent in the year 2000 and to nearly 70 percent in 2010. In addition, the growing demand for electricity will place strains on suppliers in many parts of the country. Outdated regulatory and statutory barriers also unnecessarily impede achievement of our energy and environment goals in the most efficient manner. Increased concern about clean air and the possibility of global climate change also present new challenges to reduce the environmental impacts of our energy production, transportation and use. All these challenges point to the importance of a comprehensive, balanced approach to energy policy that will allow us to use all of our Nation's energy resources-efficiency, natural gas, oil, coal, hydro, renewables and nuclear power-to meet our future energy needs. The first edition of the National Energy Strategy (NES) will balance the Nation's increasing need for energy at reasonable prices, our commitment to a cleaner and safer environment, our determination to foster economic growth, and our goal to reduce our vulnerability and that of our allies to potentially unreliable energy supplies. The Department will pursue the following major programs and themes from the NES development and their related program elements: Improving Energy Security By Reducing Vulnerability to Oil Disruptions; Increasing Energy Efficiency and Renewable Energy; and Enhancing Environmental Quality. (JF)

14723 (EFI-TR–3749) **Market based sales of electric power: Research related challenges as a consequence of the new energy law.** Wangensteen, I.; Rismark, O. Energiforsyningens Forskningsinstitutt A/S, Trondheim (Norway). Sep 1990. 90p. (In Norwegian). Order Number DE91763503. Source: OSTI; NTIS (US Sales Only).

The report describes some of the consequences envisaged today, of a change to more market based sales of electric power, as a result of the new energy law in Norway. Emphasis is put on finding those research tasks that are necessary to start with, and it is also important to obtain relevant information from abroad. The conclusion is that there exist a series of important and interesting research tasks, partly directed towards the total electric power system, and partly towards the individual production and distribution units within the system. 7 refs., 5 figs.

14724 (INIS-mf–12806, pp. 27-29) **Economic and energy prospects for Indonesia.** Samsi, M. (Embassy of Indonesia, Ottawa, ON (Canada)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Indonesia has important hydrocarbon resources, which it intends to develop so for the maximum benefit of the Indonesian people. The national energy policy is to encourage development of all energy resources, diversify away from oil, and conserve energy. Nuclear power is under consideration, with a preference for PHWR type reactors.

14725 (LBL–29878) **Local government and demand-side bidding.** Vine, E. Lawrence Berkeley Lab., CA (USA). Dec 1990. 35p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010232. Source: OSTI; NTIS; GPO Dep.

As part of Lawrence Berkeley Laboratory's (LBL) technical assistance to the Sustainable City Project, the issue of DSM bidding was examined as a possible option for local government. The recent interest and activity in DSM bidding around the country presents an opportunity for local government. Potential benefits for local government include increased installation of energy efficiency measures in municipal facilities and in the community, economic development, an additional source of revenue to help pay for municipal programs (including additional conservation efforts), and an enhanced local image. Local government will most likely participate in DSM bidding as a customer or as a client of an energy service company (ESCO). The exact role will depend on local government's response to key issues associated with DSM bidding, such

as performance guarantees, quality assurance procedures (measuring savings and providing financial security), and the administrative burden. In addition, local government will have to weigh the advantages and disadvantages of working with an ESCO. While local government has not yet participated in DSM bidding, local government is in a unique position to take advantage of energy efficiency opportunities as owner-operators of municipal facilities which consume significant amounts of energy, planners and regulators of new development, and general providers of services and assistance to their communities. Furthermore, local governments have lower risks (in terms of program success) than small businesses, and local governments' credibility and experience in dealing with customers may reduce high transaction costs associated with DSM bidding. Despite these advantages, local governments should take a cautious approach in participating in DSM bidding processes, and should carefully examine other strategies for promoting energy efficiency (including participation in conventional utility programs) prior to participating in DSM bidding.

14726 (MLM-MU–91-63-0003) **Conducting an intra-group NWQA audit: A guide for the Technology Department, Physical Sciences Section.** Barklay, C.D. EG and G Mound Applied Technologies, Miamisburg, OH (USA). 25 Mar 1991. 46p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-88DP43495. Order Number DE91009975. Source: OSTI; NTIS; GPO Dep.

This handbook establishes a method for planning and conducting an intragroup Non-Weapons Quality Assurance (NWQA) audit. It outlines a method for developing an audit checklist and gives an example of a checklist. It also outlines the requirements of an intragroup audit report and presentation and gives an example of each. The information contained, if implemented correctly, should allow a supervisor to effectively determine the compliance of his group to their established quality plan. If implemented in reasonable time prior to Mound internal audit, the supervisor should be able to initiate corrective action to eliminate any identified non-compliance concerns. This document supports Technical Manual MD-10240, Nonweapons Quality Program Plan for the Technology Department, Physical Science Sections. Requirements and controls stated here are applicable to the quality of nonweapons services and items provided by and to the Physical Science Sections. The group supervisor develops the objectives of the intragroup audit. Typical intragroup audit objectives may include, but are not limited to, the following: Determine the compliance of the group to the established quality plan.

14727 (NEI-DK–500) **Statement on energy tariffs: The interministerial committee on energy tariffs.** Energiministeriet, Copenhagen (Denmark). Apr 1990 326p. (In Danish). Order Number DE91763397. Source: OSTI; NTIS (US Sales Only).

A statement from an interministerial committee on energy tariffs published by the Danish Ministry of Energy. Denmark has the highest energy tariffs in OECD and, contrary to most other countries, sets tariffs on other energy resources than oil. The present system comprises high tariffs on oil products, slightly lower ones on coal and fairly high ones on electricity. There are no tariffs in relation to renewable energy sources or natural gas, but the price of natural gas demanded of private clients who have to pay taxes is determined on the same niveau as the oil price including tariffs. Characteristic for Denmark is that the government refunds tariffs to the major part of industry. During 1988 the expected rise in the price of raw oil did not occur and thus a new situation arose. The prospect of longer lasting energy tariffs at a higher niveau brought attention to energy tariff policy, especially in relation to the consequences to distribution and the Danish economy of the significant taxation of oil products. This resulted in a growing doubt as to the validity of the Danish energy tariff policy, and this is why the interministerial committee was established to investigate the problem and offer suggestions for a change in policy. The results of their work are presented in this statement. (AB).

14728 (SNV–3712) **Goals to an environmentally adapted energy system.** National Environmental Protection Agency, Solna (Sweden). 1990. 33p. (In Swedish). Order Number DE91763540. Source: OSTI; NTIS (US Sales Only).

Appendix 5 to the report 'An environmentally adapted energy system', STEV–1990-2.

This report deals with energy sources relevant to future use in Sweden, which means that nuclear power is excluded and that maximum output from hydroelectric power production is limited to 66 TWh. We first penetrate the environmental goals pertaining to air pollution (locally, regionally and globally) and noise, and then to other effects resulting from the exploitation of different fuels, when ground is required for the infra-structure of an energy system, and when wastes are to be stored. We also include the effects of transportation.

2940 Fossil Fuels

Refer also to citation(s) 14011, 14045, 14055, 14089, 14090, 14091, 14092, 14105, 14129, 14183, 14701, 14736, 14742

14729 (DOE/EIA–0538(90/91-24)) **Winter fuels report, week ending March 8, 1991.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 14 Mar 1991. 65p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009302. Source: OSTI; NTIS; GPO; GPO Dep.

The Winter Fuels Report is intended to provide concise, timely information to the industry, the press, policymakers, consumers, analysts, and State and local governments on the following topics: distillate fuel oil net production, imports and stocks for all PADD's and product supplied on a US level; propane net production, imports and stocks for Petroleum Administration for Defense Districts (PADD), 1, 2, and 3; natural gas supply and disposition and underground storage for the United States and consumption for all PADD's; residential and wholesale pricing data for propane and heating oil for those States participating in the joint Energy Information Administration (EIA)/State Heating Oil and Propane Program; crude oil and petroleum price comparisons for the United States and selected cities; and US total heating degree-days by city. The distillate fuel oil and propane supply data are collected and published weekly. The data are based on company submissions for the week ending 7:00 a.m. for the preceding Friday. The residential pricing information is collected by the EIA and the State Energy Offices on a semimonthly basis for the EIA/State Heating Oil and Propane Program. The wholesale price comparison data are collected daily and will be published weekly. Residential heating fuel prices are derived from price quotes for home deliver of No. 2 fuel oil and propane. As such, they reflect prices in effect on the dates shown. Wholesale heating oil and propane prices are estimates using a sample of terminal quotes to represent average State prices on the dates given. 34 figs., 12 tabs.

14730 (DOE/EIA–0543(90/4Q)) **US energy industry financial developments, 1990 fourth quarter.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. Mar 1991. 16p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009881. Source: OSTI; NTIS; GPO; GPO Dep.

During the fourth quarter of 1990, most segments of the US energy industry reported higher income. The average refiner acquisition cost of imported crude oil was over $10 per barrel higher in the fourth quarter of 1990 than in the fourth quarter of 1989, a 55-percent increase. This substantial rise in crude oil prices led to large gains in income from oil and gas production operations. These large gains accounted for most of the energy industry's higher fourth- quarter 1990 income. Overall, energy industry income rose 37 percent between the fourth quarter of 1989 and the fourth quarter of 1990. The increase in energy industry income between the fourth quarter of 1989 and the fourth quarter of 1990 was most pronounced for petroleum companies, and of this group, independent oil and gas producers showed the largest increase. The 25 independent oil and gas producers' income rose 365 percent between the fourth quarter of 1989 and the fourth quarter of 1990. Over the same period, 19 integrated major petroleum companies experienced income growth of 76 percent, primarily due to increased oil and gas production income. However, due to lower refined product sales, US refining-marketing income for major petroleum companies fell 7 percent during the fourth quarter of 1990. Eight independent refiner-marketers' income also fell over the same period, be 53 percent. For the year 1990, income for 221 energy companies rose 9.5 percent over 1989's level. Oil and gas

production operations accounted for most of this increase. For the majors, income from US oil and gas production operations rose 61 percent during 1990, while their foreign oil and gas production operations posted a 53-percent increase in income. The independent oil and gas producers registered the largest income increase in 1990, a rise of 89 percent.

14731 (ETDE-mf–1764623) **Annual report on activities 1989 of the Institute for Mineral Oil Research (Corporation under Public Law).** Institut fuer Erdoelforschung, Clausthal-Zellerfeld (Germany, F.R.). 1990 99p. (In German). Order Number DE91764623. Source: OSTI; NTIS (US Sales Only).

The main part of the book is dedicated to the most important results of research which concentrated on the following areas: Production and upgrading of mineral oil and natural gas, processing and application of mineral oil. IfE's experience on the areas: Characterisation of mineral oil and -products, colloidal chemistry of mineral oil, mineral oil recovery, oil analysis are used in order to carry out projects on the special subjects of: Enhanced oil recovery, emulsions of mineral oil, heavy oil and destillation residues of mineral oil. Further data on: Staff, budget, international activities, service sector, publications and lectures. (orig./UA).

14732 (ETDE-mf–1764785) **Black coal 1990. Annual report of the Gesamtverband des Deutschen Steinkohlenbergbaus.** Gesamtverband des Deutschen Steinkohlenbergbaus, Essen (Germany, F.R.). 1990 84p. (In German). Order Number DE91764785. Source: OSTI; NTIS (US Sales Only).

An overview is given of the situation of the world energy industry with regard to all energy carriers. Then energy-political conclusions are drawn for German black coal and the resulting prospects are detailed. Finally, some socio-political aspects are considered with regard to German black-coal mining: workforce policy, tariff policy, social security and social safeguards for the adaptation process. (HS).

2950 Hydrogen and Synthetic Fuels

Refer also to citation(s) 14367

2960 Electric Power

Refer also to citation(s) 14684, 14701, 14723, 14730, 14754, 14755, 14756, 14789, 14822, 14826, 15984

14733 (CONF-910378–1) **Geomagnetic storms: Potential economic impacts on electric utilities.** Barnes, P.R.; Van Dyke, J.W. Oak Ridge National Lab., TN (USA). 20 Mar 1991. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 4. annual electric utility business environment conference and exhibition; Denver, CO (USA); 20-22 Mar 1991. Order Number DE91009523. Source: OSTI; NTIS; GPO Dep.

Geomagnetic storms associated with sunspot and solar flare activity can disturb communications and disrupt electric power. A very severe geomagnetic storm could cause a major blackout with an economic impact of several billion dollars. The vulnerability of electric power systems in the northeast United States will likely increase during the 1990s because of the trend of transmitting large amounts of power over long distance to meet the electricity demands of this region. A comprehensive research program and a warning satellite to monitor the solar wind are needed to enhance the reliability of electric power systems under the influence of geomagnetic storms. 7 refs., 2 figs., 1 tab.

14734 (DOE/BP–1436) **Bonneville Power Administration generating resource acquisition process.** USDOE Bonneville Power Administration, Portland, OR (USA). Aug 1990. 23p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009710. Source: OSTI; NTIS; GPO Dep.

BPA relies on its Resource Program and the Council's Northwest Conservation and Electric Power Plan (Plan) to determine new firm power needs. The Resource Program estimates the need for additional power to meet BPA's firm loads, taking into account the projected growth in BPA's firm load obligations and estimates of future resource availability and cost. BPA's ability to market surplus power is also considered in determining the need for new resource additions. Additional information provided by the Resource Program includes estimates of the availability of new resources (in MW) and the expected costs of those resources. These estimates are based on supply forecasts that represent estimates of various resources (hydro, geothermal, residential and commercial conservation, etc.) available to BPA over time at different costs. In October 1988, BPA circulated an initial draft of a process for guiding the acquisition of generating resources. The draft proposed a competitive approach as a starting point for discussions with the four Pacific Northwest States (Oregon, Washington, Idaho, and Montana), the Council, BPA's customers, interest group leaders, and a Technical Review Panel convened for BPA's acquisition process development effort. These discussions led to the development of the acquisition process described in this document, which is a competitive method through which BPA plans to solicit, evaluate, negotiate, and purchase power from generating resources. 1 fig.

14735 (DOE/BP–1512) **1990 Pacific Northwest loads and resources study.** USDOE Bonneville Power Administration, Portland, OR (USA). Dec 1990. 104p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009686. Source: OSTI; NTIS; GPO Dep.

The Pacific Northwest Loads and Resources Study analyzes the Pacific Northwest's projected loads and available generating resources in two parts: (1) the loads and resources of the federal system, for which BPA is the marketing agency; and (2) the larger Pacific Northwest regional profile, which includes loads and resources in addition to the federal system. The loads and resources analysis in this study emulates the operation of the power system under the Pacific Northwest Coordination Agreement as completed by the Pacific Northwest Coordinating Group. This study presents the federal system and regional analyses for five load forecasts: high, medium-high, medium, medium-low, and low. This analysis projects the yearly average energy consumption and resource availability for Operating Years 1991–92 through 2010–11. The study shows the federal system's and the region's monthly estimated maximum electrical demand and monthly maximum generating capability – capacity – for OY 1991–92, 1996–97, 2001–02 and 2010–11. The federal system and regional monthly capacity surpluses/deficits are summarized for 20 operating years. 17 figs., 11 tabs.

14736 (DOE/EIA–0226(91/03)) **Electric Power Monthly, March 1991.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 18 Mar 1991. 189p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009828. Source: OSTI; NTIS; GPO; INIS; GPO Dep.

The Electric Power Monthly (EPM) presents monthly summaries of electric utility statistics at the national, Census division, and state level. The purpose of this publication is to provide energy decisionmakers with accurate and timely information that may be used in forming various perspectives on electric issues that lie ahead. Data are presented on generation, fuel consumption, stockpiles, costs, sales, and unusual occurrences. Fuels considered are: coal, petroleum, natural gas, nuclear power, and hydroelectric power. 4 figs., 48 tabs.

14737 (INIS-mf–12806, pp. 124-127) **Luncheon.** Kim, Chong Joo (Korea Atomic Industrial Forum (Republic of Korea)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

In 1952 the peak output of Korea Electric Company was 112 MW for a population of 22 million. In 1982 the annual peak output was 6660 MW. As the electricity supply grew, so did the per capita GNP - from 87 dollars (U.S.) in 1962 to 1678 dollars in 1982. There has been a close correlation between electricity consumption and GNP in Korea. Productivity improvements in the industrial and agricultural sectors can also be linked to the availability of electric power.

14738 (KTM/E-B–75) **Electricity in the 1990s; update of the Growth-of-the-Demand Scenario.** Kauppa-ja Teollisuusministerio,

Helsinki (Finland). Energiaosasto. 1990. 30p. (In Finnish). Order Number DE91763440. Source: OSTI; NTIS (US Sales Only).

The aim of the survey has been to estimate the sufficiency of and need for, electricity supply capacity in Finland during the 1990s. The survey is an update of the Growth-of-the-Demand Scenario published by the Energy Department of the Ministry of Trade and Industry in March 1989. The rate of economic growth assumed for the survey is based on the economic policy aspirations to decrease the current-account deficits in foreign trade. The real prices of imported fossil fuels are assumed to rise by more than one-fourth during the period under review. On the other hand, the real price of electricity is assumed to rise only slightly. Therefore price in itself would not seem to have any significant effect on the development of the consumption of electricity. The total consumption of electricity is estimated to approximate 80.2 TWh in the year 2000 and 85.7 TWh in 2005. The average consumption in the period will rise by 2.3%, i.e. distinctly less than in the 1980s. The increase will be divided fairly evenly (3 to 4 TWh) among households, services, electric heating, pulp and paper industry and the other industries.

14739 (LBL–30141) **End-use load shape data application, estimation, and collection: A state-of-the-art review.** Eto, J.H. (Lawrence Berkeley Lab., CA (USA)); Akbari, H.; Pratt, R.G.; Braithwait, S.D. Lawrence Berkeley Lab., CA (USA). Jun 1990. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-900833–15: ACEEE summer study on energy efficiency in buildings, Pacific Grove, CA (USA), 26 Aug - 1 sep 1990). Order Number DE91009325. Source: OSTI; NTIS; GPO Dep.

As electric utilities increasingly adopt least-cost integrated resource planning processes, their information needs about demand-side management (DSM) options expand considerably. Current utility supply-side planning methods involve detailed assessments of alternative resource plans that take explicit account of the time-varying nature of customers' demands for electricity. In order for demand-side options to be treated comparably to generation resources, planners need reliable information on their impact on system loads. Yet information on the components of aggregate electricity (i.e., end uses) and how they can be modified, especially at the level of temporal disaggregation used to evaluate generation options, is not widely available. A recent assessment of least-cost planning (LCP) concludes that uncertainty about the performance of DSM activities, including their impact on load shapes, is a major barrier to increased utility reliance on DSM for meeting customer's demands for electricity services. The goal of this paper is to assess progress in reducing this uncertainty by reviewing leading efforts to apply, estimate, and collect end-use load shape data for utility planning purposes. We begin by reviewing utility applications of end-use load shape data. For the purposes of this paper, these applications constitute the primary "demand" for load shape data. In the subsequent two sections, we review current efforts to obtain end-use load shape data by estimation and by direct metering. Our discussion of these three topics begins with a brief historical summary and is followed by a review of the current state-of-the-art. We also speculate on promising future areas of research. These speculations form the basis for a final section, which describes our vision of the next generation of end-use load shape data applications, estimation, and collection. 44 refs., 1 tab.

14740 (NEI-DK–465) **Availability statistics for thermal power plants.** Nordel. 1988 39p. (In Swedish, Finnish, English) Order Number DE91624791. Source: OSTI; NTIS (US Sales Only); INIS.

Denmark, Finland and Sweden have adopted almost the same methods of recording and calculation of availability data. For a number of years comparable availability and outage data for thermal power have been summarized and published in one report. The purpose of the report now presented for 1988 containing general statistical data is to produce basic information on existing kinds of thermal power in the countries concerned. With this information as a basis additional and more detailed information can be exchanged in direct contacts between bodies in the above mentioned countries according to forms established for that purpose. The report includes fossil steam power, nuclear power and gas turbines. The information is presented in separate diagrams for each country, but for plants burning fossil fuel also in a joint NORDEL statistics with data grouped according to type of fuel used. The grouping of units into classes of capacity has been made in accordance with the classification adopted by UNIPEDE/WEC. Values based on energy have been adopted as basic availability data. The same applies to the preference made in the definitions outlined by UNIPEDE and UNIPEDE/WEC. Some data based on time have been included to make possible comparisons with certain international values and for further illustration of the performance. For values given in the report, the definitions in the NORDEL document "Concepts of Availability for Thermal Power, September 1977", have been applied. (author).

14741 (NRRI–90-15) **Implementing a competitive bidding program for electric power supply.** Rose, K.; Burns, R.E.; Eifert, M. National Regulatory Research Inst., Columbus, OH (USA). Jan 1991. 313p. Sponsored by National Association of Regulatory Utility Commissioners, Washington, DC (USA). Source: OSTI; National Regulatory Research Inst., 1080 Carmack Rd., Columbus, OH 43210.

The Public Utility Regulatory Policies Act of 1978 (PURPA) began a series of events that has shaped the current restructuring of the electric utility industry and the way the industry is regulated. While the primary intent was to conserve energy, it also had the effect of encouraging alternative sources of generation beyond the original intent. Initially, all public utility commissions required utilities to pay PURPA-qualified facilities (QFs) an administratively determined avoided-cost rate. Increasingly, however, many commissions and utilities are turning to competitive bidding to determine a rate for purchased power. A survey of March 1990 found competitive bidding programs operating in twenty-six states. The competitive bidding process has five stages: solicitation, evaluation, selection, negotiation, and contracting. Designing a competitive bidding program for power supply requires the public utility commission and/or utility to consider many interdependent elements that occur in each of these stages. Four legal issues concern the negotiating and contracting stages of bidding and many state commissions lack the authority to solve them. (1) Legal issue concerns transmission access. Lack of access may limit the economic advantages to be gained from bidding. (2) The current structures of the Public Utility Holding Company Act of l935 (PUHCA) may retard development of an independent power production industry because potential owners do not want to assume the legal requirements of the PUHCA. (3) Competitive bidding affects the siting and certification-of-need procedures of state commissions. (4) State/federal jurisdictional conflicts can arise because of competitive bidding, since FERC has exclusive jurisdiction to set wholesale power rates. A competitive bidding program should be a joint product of state and federal regulators, utilities, consumer groups, nonutility generators, and other interested parties. 72 refs., 7 figs., 15 tabs. (JF)

14742 (SR/NES–90-03) **Electricity supply: Supporting analysis for the National Energy Strategy.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 18 Jan 1991. 48p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009201. Source: OSTI; NTIS; INIS; GPO; GPO Dep.

This report has been prepared by the Energy Information Administration at the request of the Department of Energy's Office of Policy, Planning and Analysis. The results are based on assumptions provided by the Department of Energy's Office of Conservation and Renewable Energy, the Office of Nuclear Energy, the Office of Fossil Energy, and the Office of Policy, Planning and Analysis. This report serves as an auxiliary document to the publication, Improving Technology: Modeling Energy Futures for the National Energy Strategy, prepared by the Energy Information Administration (EIA), to be used as input to the development of a National Energy Strategy. The excursions discussed in this report are not necessarily the policy options which will be selected for inclusion in the National Energy Strategy (NES). This report examines the effects of various supply side options for electric utilities. The three excursions presented are: (1) Effects of the Clean Air Act Amendments on Reducing SO_2/NO_x Emissions which evaluates the impacts of proposed legislation to amend the Clean Air

Act (Title V of H.R. 3030 as amended on May 23, 1990); (2) Nuclear Life Extension/New Nuclear Orders which illustrates the impact of new nuclear power plant orders and the life extension of existing nuclear plants; and (3) Nuclear and Accelerated Fossil-Fueled Generating Technologies which portrays accelerated research and development of advanced fossil-fueled generating technologies, making them commercially available earlier, with the inclusion of the nuclear option. The baseline case of this report is an update and an extension of the base case projections in the Energy Information Administration (EIA) publication, the Annual Energy Outlook 1990 (AEO), extending that forecast an additional 20 years to 2030. It represents the baseline case as it was on July 1990. 29 refs., 9 figs., 19 tabs. (JF)

2980 Consumption and Utilization

Refer also to citation(s) 14681, 14701, 14720, 14736, 14739, 14789, 14822, 14826, 14912

14743 (ECN-I–91-006) **Basic tables of the energy consumption 1985.** Tiemersma, D.N.; Rouw, M. Netherlands Energy Research Foundation, Petten (Netherlands). Jan 1991. 35p. (In Dutch). Order Number DE91760569. Source: OSTI; NTIS (US Sales Only).

Reliable and useful tables of one basic year are necessary to maintain and to actualize the energy scenarios of the Energy Study Centre of the Netherlands Energy Research Foundation. Spring 1989 such basic tables were composed for the Dutch energy consumption in 1985. A basic structure has been designed to classify energy demand data. Three main sectors are distinguished: the built environment, the production system, and the transportation sector. Within each sector several subsectors can be distinguished. The energy sources considered are: coal, oil, natural gas, electric power, hot water and steam, and different gases. The energy is used for space heating, processes and electric power. In the appendix account is given of the sources of the data. The tables presented are deducted from the Dutch Energy Economy (NEH) tables and supplemented by several other sources. 25 refs., 15 tabs.

14744 (ETY–27/1990) **Consumption of electric energy in services.** Koski, P. (Ekono, Helsinki (Finland)); Suomalainen, E.P. Finnish Energy Economy Association, Helsinki (Finland). 1990. 100p. (In Finnish). Project KTM-179/881/88. Order Number DE91763441. Source: OSTI; NTIS (US Sales Only).

In the study the service field has been handled as a whole including buildings, infrastructure and so on. The most important consumer groups are still the public and service buildings. It is considered important to have a proper consumption statistics in energy boards so that the use of electric energy in the whole country is possible to analyze. Development proposals for future energy statistics have been made e.g. the division of consumer groups more individually and make the statistics separately for consumers of different joining year. The energy files in energy boards have been developed in this project so that it was easy to link together the monthly readings of different consumers and analyze those statistically by personal computers. This is how the changes of energy consumption are possible to follow and analyze in large groups more individually than today. In 1988 the total consumption of service consemers analyzed here was 4.5% greater than in 1987. The monthly readings revealed that it was probably due to the high consumption of cooling devices during the exceptionally warm summer 1988. In 1989 the consumption of about 2500 consumers was only 0.6% greater than in 1988. However, the changes of the consumption of individual consumers were common and surprisingly big. That is why the amount of consumers has to be large for statistical studies. Renewing the gathering of energy readings later for consumers discussed here, as it has been planned in the beginning of the project, it is possible to get information of a longer period and on the basis of that make more reliable and applicable conclusions.

14745 (SV-US–90-60) **The importance of electrical energy for industrial development in Sweden.** Schoen, L. (Lund Univ. (SE)). Swedish State Power Board, Vaellingby (Sweden). 28 Dec 1990. 140p. (In Swedish). Order Number DE91763513. Source: OSTI; NTIS (US Sales Only).

The aim of the study is to clarify the role of electricity in Swedish industrial development in a long term perspective - encompassing the period from the breakthrough of electricity in the 1890s up to now. The present analysis is primarily devoted to the importance of electricity in transforming the orientation of production and in accomplishing increases in efficiency in the use of resources within industry. The leading question has been to what extent Swedish supply of electricity has supported industrial development, i e the ability of allocating and using resources in manners to sustain long term growth. To this analysis, a comprehensive statistical material has been collected and elaborated. The starting point of the analysis has been a long term pattern of change in Swedish economy and industry according to which periods characterized by structural transformation have been followed by periods of rationalisation ending in short periods of structural crisis. The analysis show that this structural development was closely related to the development of the use of electricity in industry. The specific use of electricity has developed discontinously with increases during periods of structural transformation which have been periods of profound renewal within industry. The strong link between the supply of electricity and the renewal of the industrial structure is the basic result of the study. During periods of structural transformation, new branches of growth have appeared that to a relatively great extent have taken advantage of the specific qualities pertaining to electricity as a carrier of energy. In heavy energy consuming industries, the use of electricity has furthermore been part of a development towards a more efficient use of raw materials, energy and labour. (author) (66 refs.).

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 14408, 14434, 14436, 14443, 14454, 14677, 14701, 14734, 14736, 14822

14746 (CONF-9004131–, pp. 11-16) **The national energy strategy - the role of geothermal.** Mock, J.E. USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Geothermal Div. [1990]. From The national energy strategy–the role of geothermal technology development; San Francisco, CA (USA); 18-20 Apr 1990. In *The National Energy Strategy - The role of geothermal technology development: Proceedings. Geothermal Program Review 8: Proceedings.* 185p. Order Number DE91004623. Source: OSTI; NTIS.

Early in his administration, President Bush directed Secretary Watkins of the Department of Energy to develop a National Energy Strategy (NES) to be a dynamic strategy to provide the US with adequate supplies of clean, competitively priced energy into the next century. The paper briefly describes the Interim NES report and what it contains. The role of geothermal energy in expanding the energy resources and The Geysers research project are discussed. Other research activities on geothermal energy of the US DOE for fiscal year 1990 are summarized.

14747 (DOE/BP–1487) **Pacific Northwest and Alaska Regional Bioenergy Program: Five year report, 1985–1990.** Chase, C.L. (ed.)— (Biomass Energy Systems and Energy Resource Management, Bellevue, WA (USA)). USDOE Bonneville Power Administration, Portland, OR (USA); Biomass Energy Systems and Energy Resource Management, Bellevue, WA (USA). Feb 1991. 55p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009700. Source: OSTI; NTIS; GPO Dep.

This five-year report describes activities of the Pacific Northwest and Alaska Regional Bioenergy Program between 1985 and 1990. Begun in 1979, this Regional Bioenergy Program became the model for the nation's four other regional bioenergy programs in 1983. Within the time span of this report, the Pacific Northwest and Alaska Regional Bioenergy Program has undertaken a number of applied research and technology projects, and supported and guided the work of its five participating state energy programs. During this period, the Regional Bioenergy Program has brought together public- and private-sector organizations to promote the use of local biomass and municipal-waste energy resources and technologies. This report claims information on the mission, goals

and accomplishments of the Regional Bioenergy Program. It describes the biomass projects conducted by the individual states of the region, and summarizes the results of the programs technical studies. Publications from both the state and regional projects are listed. The report goes on to consider future efforts of the Regional Bioenergy Program under its challenging assignment. Research activities include: forest residue estimates; Landsat biomass mapping; woody biomass plantations; industrial wood-fuel market; residential space heating with wood; materials recovery of residues; co-firing wood chips with coal; biomass fuel characterization; wood-boosted geothermal power plants; wood gasification; municipal solid wastes to energy; woodstove study; slash burning; forest depletion; and technology transfer. 9 figs., 6 tabs.

30 DIRECT ENERGY CONVERSION

Refer also to citation(s) 14703

3001 MHD Generators

Refer also to citation(s) 14483

14748 (DOE/ET/10815–155) **The magnetohydrodynamics Coal-Fired Flow Facility: Technical progress report, July 1, 1990–September 30, 1990.** Tennessee Univ., Tullahoma, TN (USA). Space Inst. Mar 1991. 86p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-79ET10815. (UTSI–90-06). Order Number DE91010674. Source: OSTI; NTIS; GPO Dep.

In this quarterly technical progress report, UTSI reports on the results of a multi-task contract to develop the technology need for a steam bottoming plant for a combined cycle MHD steam power plant. The primary emphasis is on proof-of-concept (POC) testing of the steam bottoming plant components. During this quarter, a 252 hour test was completed with Eastern coal which completes 1760 hours of the planned 2000 hours of testing with this coal. The performance of the baghouse and electrostatic precipitator (ESP) during the test is summarized. The baghouse met new source performance standards (NSPS) for particulate emission. The ESP performance was improved over recent past tests and its performance was mapped as a function of specific collection area (SCA) and plate rapping frequency. The results of analysis of tube materials after the first 500 hours of exposure is noted as being separately published as a topical report. Representative results of deposition on heat transfer tubes during the test are presented along with heat transfer coefficients of the dirty tubes. The results of advanced instrumentation experiments by both UTSI and Mississippi State University (MSU) are summarized. Measurements of pollutants dispersed from the CFFF stack to remote air quality monitoring trailers are presented. Test results on a ceramic tube that is a candidate for high temperature air heater service are included. The test of a prototype of the first stage of the TRW 20 MW_t combustor was successfully carried out in the combustor during the POC test this quarter. It was installed with adapter flanges to the 20 MW_t single stage combustor used in the CFFF. A report of the performance of this test article is appended to the report. 2 refs., 24 figs., 8 tabs.

14749 (DOE/PC/90274–T9) **MHD Integrated Topping Cycle Project: Tenth quarterly technical progress report, November 1989–January 1990.** TRW Space and Technology Group, Redondo Beach, CA (USA). Applied Technology Div. Nov 1990. 160p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-87PC90274. (MHD-ITC–90-311). Order Number DE91008361. Source: OSTI; NTIS; GPO Dep.

This tenth quarterly technical progress report of the MHD Integrated Topping Cycle Project presents the accomplishments during the period November 1, 1989 to January 31, 1990. A major project milestone was completed as the Preliminary Design reviews for the combustion, high pressure cooling, and channel subsystems were held. Investigations continued into several issues related to integration of the prototypical power train components into the CDIF. Two of the issues relate to the high pressure cooling subsystem; they concern electrical isolation methods and combustor coolant temperature. The preliminary design of the combustion and high pressure cooling subsystems was completed. Based on comments from an in-house design review, the design of the combustion subsystem slagging stage was modified to more closely resemble the 20 MW_t spool section, with thermal shield panels which are mounted directly on the pressure shell. Additional design work was performed subsequent to the DOE PDR to define methods of mounting the panels to the pressure shell. Seven tests were conducted in the coal-fired Mark VI power train to investigate second stage residence time effects and oxidizer injection configurations, and to check out the prototypical design spool section. The preliminary design of the channel subsystem was completed. A series of tests took place at Avco with the Westinghouse breadboard consolidation subsystem connected to the power takeoffs regions of the Mark VII workhorse channel. During the second test, the anode cabinet was damaged due to a malfunction. The precombustor design verification testing was completed and confirmation testing was initiated at the CDIF. Evaluations of recent CDIF data were performed to compare model calculations to measured data for conductivity, voltage drops, current density, Hall electric field, Faraday voltage, and voltage-current characteristics. 13 refs., 91 figs., 26 tabs.

14750 (DOE/PC/90274–T10) **MHD Integrated Topping Cycle Project: Eleventh quarterly technical progress report, February 1, 1990–April 30, 1990.** TRW Space and Technology Group, Redondo Beach, CA (USA). Applied Technology Div. Dec 1990. 205p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC22-87PC90274. (MHD-ITC–90-312). Order Number DE91008935. Source: OSTI; NTIS; GPO Dep.

This eleventh quarterly technical progress report of the MHD Integrated Topping Cycle Project presents the accomplishments during the period February 1, 1990 to April 30, 1990. Investigations continued into several issues related to integration of the prototypical power train components into the CDIF. Electrical isolation studies for the High Pressure Cooling Subsystem (HPCS) were completed. The Combustion Subsystem detailed design continued. A detailed design of the slagging stage cooling panel/pressure shell penetration has been completed. The prototypical panel/penetrations were manufactured and integrated in the spool section to be tested at CFFF. The second stage detailed design has been completed. The detail design of the 1A4 channel is on schedule. The electrode and inlet diffuser walls are complete, and the sidewall detail drawings are in progress. A study into the cause of the equipment malfunction during a test sequence at Avco on the Mark 7 channel (see Tenth Quarterly Report) recommended a change in the way the current references are set in the individual consolidation circuits. Rather then be set by the operator, the references are now set automatically by the control as a result of the total load current. Also, additional protection was added to the system to assure a fail-safe mode of operation. Confirmation testing continued at the CDIF with one test for 12-$\frac{1}{2}$ power hours and 13 thermal hours. Analysis of 20 MW_t and 50 MW_t power train performance data continued. The 20 MW_t test program was specifically designed to systematically evaluate the differences between coal-fired and oil-fired operation and to resolve the coal-fired power shortfall. A comparison of 20 MW_t oil-fired and coal-fired power generation tests is presented along with analyses which indicate that generator performance under both oil-fired and coal-fired conditions is equivalent. 11 refs., 147 figs., 17 tabs.

3004 Thermionic Converters

14751 (DOE/SF/17170–T25) **High-temperature alloys for high-power thermionic systems: Final report.** Shin, Kwang S.; Jacobson, D.L.; D'cruz, L.; Luo, Anhua; Chen, Bor-Ling. Arizona State Univ., Tempe, AZ (USA). Dept. of Chemical, Bio and Materials Science Engineering. Aug 1990. 133p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-87SF17170. Order Number DE91009292. Source: OSTI; NTIS; GPO Dep.

The need for structural materials with useful strength above 1600 k has stimulated interest in refractory-metal alloys. Tungsten possesses an extreme high modulus of elasticity as well as the highest melting temperature among metals, and hence is being considered as one of the most promising candidate materials for high temperature structural applications such as space nuclear power systems. This report is divided into three chapters covering the following: (1)

the processing of tungsten base alloys; (2) the tensile properties of tungsten base alloys; and (3) creep behavior of tungsten base alloys. Separate abstracts were prepared for each chapter. (SC)

3005 Fuel Cells

Refer also to citation(s) 13951, 14366

14752 (DOE/MC/23263–2877) **Cathode degradation: Final report.** Shores, D.A.; Selman, J.R.; Ong, E.T. Minnesota Univ., Minneapolis, MN (USA). Corrosion Research Center. Dec 1989. 206p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC21-86MC23263. Order Number DE90015338. Source: OSTI; NTIS; GPO Dep.

This report describes the results of a three-year study of cathode degradation in molten carbonate fuel cells involving both experimental and theoretical work. A keystone of the study is the development of a mathematical model, which describes cathode degradation in terms of the fundamental processes of a fluxing mechanism, i.e., dissolution, transport and precipitation. New fundamental data have been obtained on the solubility of NiO, especially on the effect of water vapor, and on the kinetics of NiO dissolution in $(Li_{0.62}K_{0.38})_2CO_3$, and these data have been incorporated in the model. Laboratory cell testing in 3 cm^2 cells has been carried out to obtain experimental data on degradation rates for direct comparison with the calculated results from the model. These comparisons have helped to verify several aspects of the model. For example, the model predicts with fair accuracy the location of the Ni deposit in the tile and the deposition rate. It is also fair to point out that the model is a relatively simple representation of complex processes, and it does not answer all questions about cathode degradation. Further work is needed. Because of its fundamental basis, the model can readily be upgraded and extended when further experimental data become available. The solubility studies, modeling efforts and cell testing have interacted iteratively to optimize progress. 94 figs., 24 tabs.

14753 (DOE/MC/23270–2969) **Task 1.0, Development of improved molten carbonate fuel cell.** Johnson, W.H. International Fuel Cells Corp., South Windsor, CT (USA). Oct 1990. 52p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC21-87MC23270. Order Number DE91002055. Source: OSTI; NTIS; GPO Dep.

The overall objective of this task was to develop an improved cell configuration for molten carbonate fuel cells which has improved performance, meets a 40,000 hour projected life, maintains existing cell cost, and is adaptable to a range of power plant applications. A new cell configuration designed to be manufactured using conventional and available equipment and processes was developed and verified in subscale single cells. This cell configuration is adaptable to a broad range of fuels without redesign, operating on very weak low Btu coal gas as well as high Btu gas and natural gas. The success of this program has provided the confidence to proceed with a scale-up to 8-ft^2 cells and a stack verification in a 20-cell, 25 kW stack test. Design requirements and specifications for components in an improved cell design were defined. Electrolyte requirements for the cell components were established, the estimated time-to-short was updated, and a design operating point and gas composition for single cell testing was defined. Four anode, four cathode, five matrix configurations, and three end-cell reservoirs were defined. A total of 54 single cell tests were conducted to evaluate the performance of individual improvements and combinations of improved configurations. Anodes were successfully fabricated by tape casting. A new tape cast cathode for improved electrolyte sharing, new tape cast matrix materials and matrix reinforcement, and an end-cell reservoir configuration using conductive material were developed. Reports on the separate subtasks have been processed for inclusion on the data base.

14754 (DOE/METC–90/6112, pp. 1-4) **METC perspective.** Mayfield, M.J. (Morgantown Energy Technology Center, WV (USA)). USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

DOE's [U.S. Department of Energy's] overall goal is to encourage development, by the private sector, of cost effective fuel cell systems for generating electric power and co-product heat applications that can take advantage of the outstanding cycle efficiencies and environmental characteristics of fuel cells. Our strategy for achieving this goal is to: emphasize molten carbonate fuel cells (MCFC) and solid oxide fuel cells (SOFC), recognizing that phosphoric acid fuel cells (PAFC) are near commercialization; focus on coal-derived fuels with natural gas as an interim step and also as a backup fuel; fund the research needed to resolve the major issues; fund development work through the proof of concept under the research and development program; recognize the market potential for on-site systems; work cooperatively with EPRI [Electric Power Research Institute] and GRI [Gas Research Institute] on program development and funding; and encourage private sector commercialization by U.S. industry since our program is funded by the U.S. taxpayers. The status of MCFC, SOFC, and PAFC is briefly described.

14755 (DOE/METC–90/6112, pp. 5-18) **Electric Power Research Institute 1990 fuel cell status.** Goldstein, R.H. (Electric Power Research Institute, Palo Alto, CA (USA)). USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

Phosphoric acid fuel cell (PAFC) systems for electric and gas utilities are on the verge of commercialization in the United States and overseas. Prototypes and engineering models ranging in size from 5 kW to 4.5 MW have been built and tested for periods exceeding 2 years with continuous improving performance and reliability. Unprecedented efficiency, quiet and virtually pollution-free operation, ease of siting, modularity, potential for cogeneration, dispersibility, and rapid installation time all combine to provide utility planners with significant incentives to consider this option in their future plans. A new commercialization program for molten carbonate fuel cells features the construction and operation of several 2 MW natural gas-fueled demonstration units in mid-1990. Molten carbonate (MCFC) and internal reforming molten carbonate fuel cell systems (IR/MCFC) operating on natural gas, light distillates or gasified coal have the potential for the highest fossil energy to electric energy efficiency known today. MCFC operates at 1,200°F and internal reforming of natural gas or methanol directly in the fuel cell converting them in situ to H_2 via steam reforming and water gas shift reactions can eliminate most of the external fuel processing equipment and all ancillary subsystems. Solid oxide fuel cells still in the early stage of development could ultimately be the most attractive fuel cell alternative. Several small demonstration units ranging in size from 400 W to 2 kW have now been tested in the U.S. and Japan and several 25 kW units are planned. EPRI project support includes fundamental research, component development, and major systems demonstrations. This paper summarizes some of these activities and presents the results of several recent projects.

14756 (DOE/METC–90/6112, pp. 19-23) **Gas Research Institute fuel cell activities.** Whelan, M.P. (Gas Research Institute, Chicago, IL (USA)). USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

Program highlights are given for solid oxide fuel cell and molten carbonate fuel cell development. Possible markets for these fuel cells, ranging in size from 1 kW to 200 MW, are listed. Data are also presented comparing the efficiency and emission of SO_x, NO_x, and CO_2 for the following technologies: phosphoric acid fuel cells, molten carbonate fuel cells, solid oxide fuel cells, gas engines, gas turbines, combined cycle gas, integrated coal gasification combined cycle, fluidized bed boilers, and pulverized fuel boilers.

14757 (DOE/METC–90/6112, pp. 27-36) **Development of a coal-fueled internal manifold heat exchanger (IMHEX) molten**

carbonate fuel cell stack. Benjamin, T.G. (Institute of Gas Technology, Chicago, IL (USA)); Ong, E.T.; Petri, R.J.; Remick, R.J. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The primary objective of this project is to develop and demonstrate a novel molten carbonate fuel cell (MCFC) design concept. This concept is based on an internally manifolded heat exchanger (IMHEX) cell/stack configuration. The program is structured into three main areas: System Design and Analysis, Stack Design and Development, and Stack Testing and Scale-up. Successful development and demonstration of the IMHEX concept will provide a strong alternative to externally manifolded stacks which have exhibited carbonate management problems. The contract term has been extended for 6 months to August 24, 1990. The primary objective of the extension is to establish fuel area commercial stack testing capability, including component and hardware fabrication. In general, the objective will be accomplished by using M-C Power's full area manufacturing facilities to fabricate full area active components, by development of environmentally benign binders by IGT, and by evaluation by Combustion Engineering of full area plate manufacturing. Full area plates will be fabricated through M-C Power.

14758 (DOE/METC–90/6112, pp. 37-38) **IMHEX commercialization strategy.** Camara, E.H. (M-C Power Corporation, Burr Ridge, IL (USA)); Snow, M.W. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The primary objective of this project is to develop and demonstrate in subscale stacks the novel internally manifolded heat exchanger (IMHEX) MCFC stack concept. A further objective is to establish full-area commercial stack component and hardware fabrication and testing capabilities. The primary objective of this program has been met as four subscale stack tests have demonstrated the significant advantages of the IMHEX concept over externally manifolded designs. Full-size prototype commercial fabrication has been established and a facility for testing up to 20 kW of full-area cells at 1 atm will be on stream shortly. This facility can be upgraded to pressure and 50 kW capacity. The design of a full-size IMHEX stacks is also completed and the first short full-area cell stack test will be conducted in September 1990, coupled with a reformer from Ishikawajima-Harima Heavy Industries. Based on the significant accomplishments of the technical program, M-C Power Corporation and Combustion Engineering have been developing a strategy and implementing a plan for field testing and commercialization of IMHEX®-based systems. The objectives of this strategy/plan are to: complete system design, engineering and scale-up efforts by 1993, demonstrate on-site natural gas-fueled and industrial cogeneration systems by 1995, serve the needs of electric utilities for natural gas-fueled dispersed power plants by 1997, and introduce coal gas-fueled power plants in the 1998-2000 timeframe. These objectives were established to address the elements of the power generation and cogeneration markets identified in our analysis.

14759 (DOE/METC–90/6112, pp. 39-48) **ERC's carbonate fuel cell stack development: Technical accomplishments.** Bernard, R. (Energy Research Corporation, Danbury, CT (USA)); Doyon, J.; Farooque, M.; Patel, P.; Paetsch, L.; Skok, A.; Steinfld, G.; Yuh, C. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The key objectives of this program are: define the coal-fueled carbonate fuel cell power plant conceptual design; set the carbonate fuel cell performance, life, and cost goals for the coal power plant use; and develop the carbonate fuel cell stack technology to meet these goals. Results to date are given for systems design, internally reforming stacks, stack experience and scaleup, stack performance and service life, stack components, and electrolyte management.

14760 (DOE/METC–90/6112, pp. 49-50) **ERC's MCFC stack development: Commercialization strategy.** Baker, B.S. (Energy Research Corporation, Danbury, CT (USA)). USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

During the past 18 months ERC has been working closely with a group of municipal utilities on a commercialization plan for the molten carbonate fuel cell (MCFC) using natural gas as fuel. In parallel with the activity with the municipal utilities, ERC has begun the design and construction of a 2MW per year pilot manufacturing facility for the MCFC to support reasonably priced demonstration and field tests of megawatt-size MCFC power plants. ERC has introduced two 2MW MCFC power plant systems as proposed initial market entries. Both systems are based on ERC's Direct Fuel Cell (DFC) approach, which eliminates the need for an external fuel processor. The first design is a Simplified System - which uses a minimum number of heat exchangers, once-through cooling and uses an external water supply. The second design is an Integrated System with hydrogen and air recirculation and is self-sufficient in water. The Integrated Design is more efficient but about 30% more expensive than the Simplified Design. The City of Santa Clara has announced that it would host the first 2MW demonstration plant. Clearly a 2MW MCFC field test would be a major milestone toward a coal gasification/MCFC power plant. ERC studies for DOE indicate that the ERC's Direct Fuel Cell is compatible with a variety of gasification technologies. Since the fuel cell itself is modular, a megawatt-size demonstration would lay the groundwork for similar or much larger size coal gas field tests. Overall commercialization plans include provisions for both megawatt and hundred-megawatt manufacturing facilities and products, with the larger size power plants having dual-fuel capability.

14761 (DOE/METC–90/6112, pp. 51-60) **Molten carbonate fuel cell research.** Smith, J.L. (Argonne National Laboratory, IL (USA)). USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The emphasis of this project is to develop new electronically conductive ceramic materials that are chemically and polymorphically stable in molten carbonate fuel cell (MCFC) environments and to test these materials as MCFC components (i.e., electrodes and separator sheets). The progression from stable material to actual component requires that significant effort be directed to developing the processes necessary for the fabrication of these materials into either porous electrodes or thin, dense separator sheets. Cell tests and performance data are the bases for component improvement and for insight into the fundamental cell phenomena.

14762 (DOE/METC–90/6112, pp. 61-65) **Effects of coal-derived trace species on the performance of molten carbonate fuel cells.** Pigeaud, E. (Energy Research Corporation, Danbury, CT (USA)); Yuh, Chaoyi. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The objective of this project is to assess the impact of 10 coal-derived, contaminants on the Carbonate Fuel Cell. The goal is to establish tolerance levels and reaction mechanisms of 3 major, 3 minor, and 4 trace contaminant species by three different analytical methods. Separate and also combined effects of up to 7 contaminant species will ten be experimentally studied in terms of bench scale fuel cell performance, to ultimately allow mathematical modeling of the simultaneous impact of the various selected species at their tolerance levels. The contaminants considered are: NH_3, Cd, Hg, HCl, H_2S, H_2Se, Zn, Pb, AsH_3, and Sn.

14763 (DOE/METC–90/6112, pp. 66-73) **International fuel cells MCFC technical accomplishment.** Johnson, W.H. USDOE

Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The objective of this program is to provide a novel, more efficient and more cost effective molten carbonate fuel cell design to provide electrical power from coal derived gases. Specific elements of these objectives are as follows: define a MCFC System that is competitive with other technology systems to provide electrical power using gasified coal derived from any coal gasifier including natural gas as a backup fuel; develop a new cell configuration consistent with the systems requirements that is manufacturable at a competitive cost level using conventional and available processing and equipment; scale the new cell configuration to full 8-ft^2 area and demonstrate the manufacturability using conventional processes by fabricating parts for a 20-cell stack evaluation; and assess the new cell configuration in an 8-ft^2, 20-cell stack test for 2,000 hours.

14764 (DOE/METC–90/6112, pp. 74-81) **In situ characterization of MCFC using optical diagnostics.** Palmer, B.A. (Los Alamos National Laboratory, NM (USA)); Funk, D.J. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The authors have identified three problem areas in MCFC [molten carbonate fuel cells] that have not yielded to conventional diagnostic techniques. The first of these is the variation of power production with position in the fuel cell. The second problem is the movement of the carbonate in the fuel cell. Because the carbonate layer is critical in the operation of the fuel cell, any migration of the carbonate adversely affects the performance. An adequate understanding of this process and the parameters that affect it would help in extending the life span of a fuel cell, and is related to the economic advantages. The third problem that affects fuel cells is the degradation of the performance as a result of contamination and the harsh environment of a MCFC. Again, there does not exist adequate descriptions of the physical processes involved in the degradation. Diagnostics suitable for attacking these problems need to have certain characteristics. They need to be spatially selective, they should not preturb the operation of the MCFC, they should be selective both in terms of species and in terms of the internal structure of the species. They need to be moderately rapid (orders of seconds to minutes) and they need to be able to look at transient species (ns to ms). They need to be able to look at gases and surfaces as the reactions that are important take place in these regions. Finally, they need to be able to operate in harsh environments that are found in MCFC. The technique that was selected was coherent anti-Stokes Raman spectroscopy (CARS).

14765 (DOE/METC–90/6112, pp. 123-126) **High temperature solid oxide electrolyte fuel cell power generation system.** USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

This paper discusses work currently being conducted to design, fabricate and test a 20 kWe tubular solid oxide fuel cell (SOFC) generator. The unit, called the Multi-Kilowatt Generator (MKG), will be largely self-supporting and will be fueled with natural gas. Additional objectives of this program are to identify design requirements for 20 MWe and larger coal-fueled electric power plants, to establish a reference design of a commercial coal-fueled plant, and to formulate technology development goals.

14766 (DOE/METC–90/6112, pp. 127-136) **Solid oxide fuel cell processing using plasma arc spray deposition techniques: Plasma arc spray deposition of SOFC interconnects.** Spengler, C.J. (Westinghouse Electric Corporation, Pittsburgh, PA (USA)). USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The principal objective of this program is to determine the process variables for the manufacture of self-supported fuel cells that utilize an interconnection strip deposited by plasma arc spray deposition of oxide powder. In particular, the study aims: (1) To form a gas impervious layer that resists degradation for 40,000 hrs of service operation, as a result of the low stresses due to matching the coefficient of thermal expansion to the air electrode; (2) To deposit a layer of a particular chemistry for adequate conductivity, facilitating electronically conducting cell-to-cell interconnections; and (3) to produce at least three cells with a plasma arc spray interconnection that meet a basic performance acceptance criterion.

14767 (DOE/METC–90/6112, pp. 137-145) **Monolithic SOFC technology status.** Minh, N.Q. (Allied-Signal Aerospace Company, Torrance, CA (USA)). USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The overall objective of this program is to advance materials and fabrication methodologies to develop a monolithic solid oxide fuel cell (MSOFC) system capable of meeting performance, life, and cost goals for coal-derived fuel applications. The technical effort of this program is aimed at creating a technology base that will be used to extend MSOFC development from proof of concept toward practical application. The program is still in its early stages, but the paper discusses background work on the following: fabrication process development; materials research; electrochemical performance improvement; and quality development.

14768 (DOE/METC–90/6112, pp. 146-152) **Planar SOFC development status.** Khandkar, A.C. (Ceramatec, Inc., Salt Lake City, UT (USA)); Elangovan, S. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

High temperature solid oxide fuel cells are high efficiency, high performance energy conversion devices. The major components of the cell are ceramic, with stabilized zirconia as the electrolyte, doped $LaMnO_3$ as the cathode, Ni/ZrO_2 cermet as the anode and the interconnect is made of doped $LaCrO_3$. The inherent brittle nature of the ceramic oxide materials used, coupled with their relatively low electrical conductivity, forces constraints and limitations on the design and configuration of the solid oxide fuel cell; the low conductivity dictates thin cell components and the brittle nature of the zirconia electrolyte dictates small cells. Various cell configurations have been designed and tested over the years in an attempt to accommodate these severe constraints. The objective of this project is to develop fabrication technology and test a planar geometry solid oxide fuel cell using advanced electrode and interconnect concepts. Specifically, this program addresses low cost fabrication techniques for electrolyte/electrode layers, investigation of alternate cathode materials, and alternate interconnect materials and design.

14769 (DOE/METC–90/6112, pp. 155-158) **Evaluation of novel solid electrolyte materials.** Bloom, I. (Argonne National Laboratory, IL (USA)); Krumpelt, M. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

Solid-state fuel cells have the potential for becoming one of the most trouble-free fuel cell systems. The use of a solid electrolyte virtually eliminates corrosion reactions and redistribution due to a liquid electrolyte. However, the high operating temperature (1,000C) can cause thermal stresses and interdiffusion of materials between the electrodes, interconnect material, and electrolyte. Lowering the operating temperature from 1,000°C to 500-800°C would increase the thermodynamic efficiency of the cell and lower thermal stresses and interdiffusion of the cell components and, yet, still allow internal hydrocarbon reforming. The lower operating temperature could, conceivably, lead to lower fuel cell manufacturing costs and the use of metals for cell interconnects. The new materials should

work in the tubular, flatplate and corrugated designs. The project is structured to first focus on developing new candidate electrolyte materials. Once suitable electrolyte materials have been identified, compatible electrode and interconnect materials will be developed. Central to the theme of the project is to find an electrolyte that could function as the basis of all four cell components, depending on dopant. In this way, the stresses due to thermal mismatch could be much smaller than those in a cell made from different materials. Two classes of compounds were chosen initially for evaluation: perovskites and scheelites. Each is briefly discussed.

14770 (DOE/METC–90/6112, pp. 159-170) **SOFC materials development: Chromite interconnections.** Chick, L.A. (Pacific Northwest Laboratory, Richland, WA (USA)); Bates, J.L. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

This research and development project is an effort to modify state-of-the-art SOFC materials or develop analogous SOFC materials as electrodes and interconnections that will provide improved electrical, thermal expansion and electrochemical properties. This work includes four tasks: Material synthesis and processing technology is being developed to modify state-of-the-art and alternative interconnection materials (powders) that can be sintered in air below 1,823 K with and without the use of metal additives as sintering aids; Additive effects on structure, synthesis and electrical and thermal properties are being studied for interconnection materials based on $La_{1-x}Sr_xCr_{1-y}Al_yO_3$; Electrical and thermal properties of alternative interconnection materials are being evaluated as functions of composition, structure and synthesis/fabrication methods; and Electrochemical behavior of materials and SOFC interfaces is being studied using complex AC impedance techniques coupled with simple cell geometries. The content of this report discusses R&D directed toward determining the factors that affect the air sinterability of $La_{1-x}Sr_xCrO_3$.

14771 (DOE/METC–90/6112, pp. 171-178) **Development of improved cathodes for solid oxide fuel cells.** Anderson, H.U. (Univ. of Missouri, Rolla (USA)); Nasrallah, M. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The inability of the $LaMnO_3$ based cathodes to withstand exposure to fuel gas without degrading their performance is one of the foremost problems confronting the successful commercialization of SOFC's. As part of the DOE-BES program the authors have been making some investigations within a number of the conducting perovskite systems. The systems targeted for this study are: $(La,Ca)(Cr,Co)O_3$ and $(Y,Ca)(Cr,Mn,Co)O_3$. These systems were chosen because of previous knowledge and the fact that substantial mutual solubility exists for both systems. A series of compositions in the $LaCrO_3$-$LaCoO_3$-CaO and CaO-$LaMnO_3$, $YCrO_3$-$YMnO_3$-$YCoO_3$-CaO, and CaO-$YMnO_3$ systems were synthesized using the organometallic preparation technique. Results are given on X-ray diffraction measurements, electrical conductivity, sintering, density, thermoelectric power measurements, thermal expansion, and surface morphology by scanning electron microscopy.

14772 (DOE/METC–90/6112, pp. 179-185) **Solid oxide fuel cell materials.** Singhal, S.C. (Westinghouse Electric Corporation, Pittsburgh, PA (USA)). USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The materials and fabrication processes used for the support tube, air electrode, electrolyte, interconnection, and fuel electrode in the Westinghouse tubular design solid oxide fuel cells are summarized. These materials have been chosen for their ability to perform required cell functions, to minimize any interfacial interactions under long-term cell operation, and to have closely-matched thermal expansion coefficients. A large number of cells, cell bundles and generators using these materials have been electrically tested at 1,000°C. These cells have shown excellent performance and performance stability under long-term operation, some to times up to about 15,000 hours. No major problems related to materials have surfaced in the high temperature testing that should limit the long-term application of these cells in electric generators. However, development work is continuing on alternative cell fabrication techniques which would lower the cost of the cells and also allow use of better thermal expansion matched material for the interconnection.

14773 (DOE/METC–90/6112, pp. 186-190) **Monolithic solid oxide fuel cell materials.** Minh, N.Q. (Allied-Signal Aerospace Company, Torrance, CA (USA)). USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The overall objective of this program is to advance materials and fabrication methodologies to develop a monolithic solid oxide fuel cell (MSOFC) system capable of meeting performance, life, and cost goals for coal-derived fuel applications. The technical effort of this program is aimed at creating a technology base that will be used to extend MSOFC development from proof of concept toward practical application. The materials currently used for building the MSOFC are Y_2O_3-stabilized ZrO_2 for electrolytes, Ni/Y_2O_3-ZrO_2 cermet for anodes, Sr-doped $LaMnO_3$ for cathodes, and Sr-doped $LaCrO_3$ for interconnects. The program covers a wide range of development work relating to the materials for the MSOFC. This section is limited to a brief discussion of the interconnect and development of material specifications.

14774 (DOE/METC–90/6112, pp. 193-203) **The DOE fuel cell for transportation program.** Patil, P.G. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The program objectives are: To advance fuel cell technologies, integrated with advanced power train technology, to provide electric vehicles with performance and life cycle costs competitive with internal combustion engine vehicles; To provide data and information for industry to make quality decisions on the merits of commercializing fuel cells for transportation applications; and To improve U.S. competitiveness and maintain U.S. lead in fuel cell technologies. Fuel cell technologies for transportation applications include phosphoric acid for bus application, proton-exchange membrane and monolithic solid oxide fuel cells for bus, van, and car applications. The status and preliminary results from these three DOE programs are outlined.

14775 (DOE/METC–90/6112, pp. 204-210) **The Westinghouse PAFC module design.** France, L.L. (Westinghouse Electric Corporation, Large, PA (USA)); Kelly, J.L.; Pereira, A.J.; Wright, M.K. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The main objective of this contract is to develop the basic technology needed to demonstrate the air-cooled phosphoric acid fuel cell (PAFC) performance, performance stability and cost goals associated with successful energy service. To achieve the power plant performance and economic objectives, progressive fuel cell technology objectives were established, which are: (1) average beginning-of-use performance of 690 mV at 267 mA/cm^2, 190C, 4.7 atmospheres, 83 percent hydrogen utilization using steam reformed natural gas (SRG) and 50 percent oxidant utilization using air; (2) performance stability consistent with a voltage loss of 8 mV/1,000 hours, and (3) a 375 kW rated module that can be manufactured for $2,600/kW without employing mass production techniques. Modest performance and performance stability improvements will be needed to achieve a mature commercial power plant at similar rated conditions. Results are presented on module parameters, pressure vessel, coolant air system, process gas systems, and acid addition system.

14776 (DOE/METC–90/6112, pp. 211-220) **Development of CO and H_2S tolerant PAFC anode catalysts.** Jalan, V. (ElectroChem, Inc., Woburn, MA (USA)); Poirier, J.; Desai, M.; Morriseau, B. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The currently-used PAFC systems derive their oxygen from ambient air and hydrogen from relatively clean reformed fuel (methanol, natural gas., etc.). The commercial attractiveness of the PAFC system would be greatly enhanced if it could use coal gas from a gasifier as its fuel source. However, the presence of high levels of CO and H_2S in coal-derived gases causes much larger anodic polarizations than those obtained from reformed methanol or natural gas. This restriction to relatively clean fuel could be overcome and coal gas could be used in a fuel cell if the poisoning effects of CO and H_2S were reduced. An anode catalyst enabling PAFC operation on gasified coal represents a near term means of achieving efficient coal utilization as well as reducing the fuel processor requirements for sulfur containing reformed fuels while maintaining the same level of performance. Twenty-five anode Pt-based electrocatalysts were prepared, characterized, and evaluated in the floating electrode half cell. Further improvements in performance were realized by alloying. The effects on anode polarization of catalyst composition, surface area, support, and fuel gas composition were investigated in detail. The effects of contaminant concentration, temperature, pressure, and fuel utilization on an ultra-high surface area Pt catalyst were also examined in the full cell. A CO and H_2S tolerant high surface are binary Pt alloy was developed and evaluated in the full cell. Long term contaminant resistance and performance stability were demonstrated during atmospheric pressure life testing using a simulated coal gas mixture. Similar testing at increased pressure is currently underway.

14777 (DOE/METC–90/6112, pp. 221-229) **Impurity tolerant electrocatalysts.** Paffett, M.T. (Los Alamos National Laboratory, NM (USA)); Gottesfeld, S. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

This project has two central goals. The primary research effort addresses fundamental aspects of Pt electrocatalyst poisoning by CO and an understanding of practical schemes for improving the CO tolerance of electrocatalytic materials. The second mission of this work is an attempt to address, on a fundamental level, the surface chemical properties that enhance the direct electrooxidation of methanol at binary Pt alloy electrode surfaces. The authors have explored the physical and chemical basis of elimination of CO poisoning effects by direct injection of low levels (~1%) of O_2 into the anode feed stream of working single fuel cells. The fuel cell systems examined include both polymer electrolyte (PEFC) and phosphoric acid fuel cells (PAFC). This examination has included model studies of O_2 coinjection with low levels of CO at Pt rotating disk electrodes and exhaust gas analysis of working fuel cells. The authors have examined the surface structural properties and reactivity of Sn/Pt surface alloys prepared by vapor deposition of Sn onto single crystal substrates followed by annealing (1,000K). These studies have included a variety of surface analysis characterization studies. In addition, the reactivity of these templates with respect to small molecule adsorbates and the electrochemical reactivity towards direct methanol electrooxidation have also been examined. The surface properties and reactivity of other bimetallic electrocatalytic materials (e.g., PdAu, PdSn) will also be examined using the same set of techniques and methods as described for the PtSn surface alloys.

14778 (DOE/METC–90/6112, pp. 230-234) **Improved electrolytes for fuel cells.** Gard, G.L. (Portland State Univ., OR (USA)); Roe, D.K. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

Present-day fuel cells based upon hydrogen and oxygen have limited performance due to the use of phosphoric acid as the electrolyte. Improved performance is desirable in electrolyte conductivity, electrolyte management, oxygen solubility and the kinetics of the reduction of oxygen. Attention has turned to fluorosulfonic acids as additives or substitute electrolytes to improve fuel cell performance. The objectives of this project are: To design, synthesize and characterize new and known fluorosulfonic acids/salts for use as fuel cell electrolytes; To carry out a planned structural study of fluorosulfonic acids that will evaluate factors such as stability, acidity, surface activity, oxygen solubility, conductivity, and overall fuel cell performance brought about by (i) substituent/terminal grouping, (ii) chain-length and (iii) heteroatoms in the chain; To carry out studies involving synergistic effects of fluorosulfonic acids with phosphoric acid systems; Determine the characteristics of the reduction of oxygen in solutions of these acids and as additives to phosphoric acid; Evaluate the reduction of oxygen in these acids over a wide temperature range using a disk electrode made from platinum and a ceramic base; and Identify the presence of surface active compounds with FTIR and IRRAS.

14779 (DOE/METC–90/6112, pp. 235-242) **Improved anode catalysts for coal gas-fueled phosphoric acid fuel cells.** Kosek, J.A. (Giner, Inc., Waltham, MA (USA)); Kackley, N.D. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The overall program goal is the development of low-cost, carbon-supported anode catalyst for the phosphoric acid fuel cell (PAFC) that can efficiently operate with a fossil fuel-derived hydrogen gas feed contaminated with carbon monoxide, hydrogen sulfide and carbonyl sulfide. The standard anode catalyst, 10% Pt/Vulan XC-72 requires clean hydrogen fuel (hydrogen containing a minimum quantity of the above contaminants). At significant concentration levels, contaminant gases will typically adsorb on the platinum catalytic sites, reducing activity for hydrogen oxidation and reducing the cell output voltage. By increasing the tolerance of the anode catalyst to contaminant gases, the cost of gas cleanup necessary in a coal gas-fueled PAFC power plant can be reduced, thereby reducing the overall power cost of the electricity produced. The technical approach being investigated is to develop alloy catalyst systems which will operate efficiently on hydrogen gases containing high levels of contaminants. In addition to impurity tolerance, catalyst systems were tested for their ability to extract energy from the carbon monoxide component through (1) generation of additional hydrogen by promoting the CO/H_2 water shift reaction or (2) direct oxidation of CO to CO_2 with the same result.

14780 (DOE/METC–90/6112, pp. 243-245) **Status of development of water-cooled phosphoric acid fuel cells.** Breault, R.D. (International Fuel Cells Corportion (IFC), South Windsor, CT (USA)); Randall, S.A.; Scheffler, G.W. USDOE Morgantown Energy Technology Center, WV (USA). May 1990. (CONF-900591–: 2. Fuel cells contractors review meeting, Morgantown, WV (USA), 2-3 May 1990). In *Proceedings of the second annual fuel cells contractors review meeting.* 263p. Source: OSTI; NTIS.

The objective of this research and development effort is to improve the performance and minimize the cost of the existing water-cooled electric utility, phosphoric acid fuel cell stack technology. The improved stack technology shall be capable of demonstrating a power density of at least 175 watts per square foot over a 40,000 hour useful life and a projected manufactured cost of less than $400 per kilowatt in initial production. The design and results to date are described.

14781 (NEI-DK–499, pp. 1-11) **Fuel cells.** Simonsen, P. (Elkraft A.m.b.A. (DK)). Dansk Automationsselskab, Lyngby (Denmark). 1990. 157p. (In Danish). (CONF-9002180–: Conference on decentral cogeneration plants and industrial heat and power production, Lyngby (Denmark), 28 Feb 1990). In *Decentral cogeneration plants and industrial heat and power production.* Order Number DE91763388. Source: OSTI; NTIS (US Sales Only).

A short explantation of the way fuel cells work is followed by discriptions of the various types and how they can be utilized in cogeneration plants. In relation to a brief review of the status of current research on, and production of, fuel cells in Denmark, a list of relevant institutions and firms is presented. In the conclusion, fuel cell applications and the advantages of utilizing them in power plants are enumerated. (AB).

14782 Thin carbon plate suitable for use as fuel cell separator. Saito, Kazuo; Imashiro, Yasuo. 10 Jul 1990. Japan Patent priority 30400388;CA patent application 2004135. 25p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A thin carbon plate having excellent gas impermeability and mechanical strength is provided, which is particularly suitable for use as a fuel cell separator, for example in a phosphoric acid fuel cell. According to one aspect of the invention, the plate is obtained by forming a polycarbodiimide resin into a thin plate and carbonizing the thin plate. In another aspect, the plate is obtained by forming a mixture of polycarbodiimide resin and polycarbodiimide fibers into a thin plate and carbonizing the thin plate. The thin carbon plate produced according to the invention has a preferred thickness of 0.1 to 1.5 mm, and preferably has the following properties: bulk density, 1.5-1.8 g/cm^3; gas permeability 10^{-5} to 10^{-8} cm^3/min.cm^2; inherent resistivity 1.0 to 6.0 m-ohm.cm; tensile strength 15 to 30 kg/mm^2; and Young's modulus 2,000 to 3,500 kg/mm^2. The plate of the invention also has excellent resistance to phosphoric acid. Experiments are described to illustrate the fabrication of thin carbon plates according to the invention. 2 tabs.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

14783 (CONF-9103153–1) **Measuring the effects of conservation program special services: Client education, fuel assistance, and other indirect outcomes.** White, D.L. Oak Ridge National Lab., TN (USA). [1991]. 19p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 5. affordable comfort conference; Philadelphia, PA (USA); 12 Mar 1991. Order Number DE91010142. Source: OSTI; NTIS; GPO Dep.

Conservation program special services are program components that have been designed into the package of program services. As a result, a quantifiable measure of the effectiveness of these services on program goals and objectives is difficult to obtain. Methods that have been designed to control for confounding effects of intercorrelated program services are usually inadequate. For instance, effective education is multi-faceted; the most desirable characteristics of education cannot be separated from one another and individually assessed. Many special services like client education and non-energy impacts (e.g., fuel assistance, quality control of weatherization work, weatherization activity that improves comfort, etc.) are receiving increasing attention from policy-makers. Not only is energy savings an important measure of program success, but indirect outcomes like the benefits of client education, reductions in average and absolute customer delinquent accounts, improvements in comfort, and the affordability, quality, and longevity of housing are also important measures of a program's success in delivering services to the community. In this paper the author will examine the potential effects of client education, fuel assistance, and other indirect outcomes of residential energy conservation programs. 39 refs., 2 figs., 3 tabs.

14784 (ENET–8900171/1) **Synthesis of energy management in horticulture.** Reist, A. (and others); Baumgartner, J.P.; Burnier, J. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Oct 1989. 94p. (In French). Order Number DE91765822. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The research projects 'serre-pilote CERN' and 'HORTICERN' (1982-1988) resulted in a comprehensive economical evaluation of energy saving techniques in horticulture: the HORTICERN computer program allows the calculation of energy consumption as related to local climate, greenhouse type, equipments and crop management. The effects of energy saving techniques on plant growth, harvest time, yields and quality of products were assessed on five different crops and during eleven growth seasons. Complementary studies on heating systems, irrigation and soilless culture were also performed along with the project and detailed reports are included. A model of economic analysis is proposed to optimize energy saving investments. (author) figs., tabs., 52 refs.

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Refer also to citation(s) 14426, 14431, 14839, 15023

14785 (BRE-IP–16/20) **The BRE low-energy office: an assessment of electric heating.** John, R.W.; Willis, S.T.P.; Salvidge, A.C. Building Research Establishment, Watford (UK). Dec 1990. 4p. Order Number DE91763850. Source: OSTI; NTIS (US Sales Only).

The low-energy office (LEO) at the Building Research Establishment in the United Kingdom (BRE) was refurbished during the summer of 1988 to allow an independent assessment of the concepts associated with electric heating in highly insulated, naturally ventilated buildings. This paper, which details results from this assessment, is addressed to architects, developers, building services and heating engineers, and all those concerned with the thermal behaviour of buildings. (author).

14786 (CONF-8610224–2) **Analysis and field evaluation of an advanced ground-coupled heat pump system.** Baxter, V.D. (Oak Ridge National Lab., TN (USA)); Catan, M.A.; Hughes, H.M.; Hughes, P.J.; O'Neil, R.A. Oak Ridge National Lab., TN (USA). [1986]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From Workshop on ground-source heat pumps; Albany, NY (USA); 27 Oct - 1 nov 1986. Order Number DE91009634. Source: OSTI; NTIS; GPO Dep.

This paper addresses the performance of a ground-coupled heat pump (GCHP) system with a water-source heat pump (WSHP) package designed expressly for such systems for a northern climate. The research objective was to minimize the life-cycle cost (LCC) of a GCHP system by optimizing the design of both the heat pump package and the ground heat exchanger in concert. The LCC of a GCHP system with a horizontal ground heat exchanger was minimized over a seven-year economic life for an 1800 ft^2 (167 m^2) house in Pittsburgh, PA, USA. Simple payback for the optimized system, relative to conventional air-source heat pumps (ASHPs), was less than three years. The resulting WSHP design is calculated to cost approximately 20% more than its conventional counterpart, but offers a 20% higher heating coefficient of performance (COP) and a 23% higher cooling COP. The major conclusion of this study is that by improving the WSHP package efficiency, the ground heat exchanger size can be reduced by at least 30% without sacrificing performance; this can yield significant improvement in the cost competitiveness of GCHP systems. 10 refs., 8 figs., 8 tabs.

14787 (CONF-9106132–1) **Thermal resistance of prototypical cellular plastic roof insulations.** McElroy, D.L.; Graves, R.S.; Weaver, F.J. Oak Ridge National Lab., TN (USA). [1991]. 28p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 2. international workshop on long-term thermal performance of cellular plastics; Ontario (Canada); 5-7 Jun 1991. Order Number DE91009144. Source: OSTI; NTIS; GPO Dep.

A cooperative industry/government project was initiated in 1989 to evaluate the viability of alternative hydrochlorofluorocarbons (HCFCs) as blowing agents in polyisocyanurate (PIR) boardstock for roofing applications. Five sets of PIR boardstock were produced to industry specifications for current roof insulation technology. The boardstock allowed the performance of four alternative blowing agents (HCFC-123, HCFC-14lb, and two blends of HCFC-123 and HCFC-14lb) to compared to CFC-11. Laboratory and field tests show the relative thermal performance of the individual PIR boards. One set of laboratory tests show the thermal conductivity (k) from 0 to 50°C (30 to 120°F) of boards prior to installation and as a function of time after exposure to field conditions in the Roof Thermal Research Apparatus (0, 9, and 15 months). Another set of laboratory tests show k as a function of aging time 24°C (75°F) and 65°C (150°F) for full-thickness, half-thickness, and quarter-thickness specimens. These test results and modeling calculations

show the value of thin specimen testing as an accelerated aging procedure. 24 refs., 5 figs., 7 tabs.

14788 (DOE/BP–1427) **Builder's field guide to energy efficient construction.** Schwartz, L. (ed.) (Oregon State Univ., Corvallis, OR (USA). Extension Energy Program); Boe, B. USDOE Bonneville Power Administration, Portland, OR (USA); Oregon State Univ., Corvallis, OR (USA). Extension Energy Program. Oct 1990. 139p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009692. Source: OSTI; NTIS; GPO Dep.

The Builder's Field Guide presents approaches to energy efficient construction used throughout the Northwest. The Field Guide references 1991 Super Good Cents standards and the 1987 Northwest Energy Code. But the construction techniques describes will help you meet energy efficient construction standards wherever you build. Codes and incentive programs vary from area to area. You'll need to verify that an approach accepted in one area is OK to use in another. Your local utility or building department will help you learn local requirements and find the best way to meet them. Regional model conservation standards are the basis of local codes, state codes, and Super Good Cents specifications. The model standards were developed by the Northwest Power Planning Council, a regional power planning body created by the 1980 Northwest Electric Power Planning and Conservation Act. The model conservation standards are bottom-line performance standards. They may be met in a number of ways. Local governments, states, and utilities may tailor the standards to better suit local building practice and meet other local needs. Northwest conservation programs referenced in the Builder's Field Guide include. 67 figs.

14789 (DOE/BP–1516) **Super GOOD CENTS Submetering Program: Annual report #3.** Barnett, C. USDOE Bonneville Power Administration, Portland, OR (USA). Residential Technology Section. Dec 1990. 36p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009689. Source: OSTI; NTIS; GPO Dep.

This report reviews data submitted to Bonneville Power Administration (BPA) for space heating in Super GOOD CENTS (SGC) homes. Submetering is a part of the SGC program. It was developed to provide BPA with specific information about space heating in SGC homes. Although this report contains some simple analysis, it is intended to provide information and not conclusions to the reader. The program requires installing an additional meter that records only the portion of energy consumption used by space heating. Readings of this meter are taken when the utility, or wholehouse, meter is read. The utility collects this data and submits it to BPA. Utilities receive up to $400, $200 per year with a two year maximum, for each home metered. BPA must receive 24 months (730 days) of monthly data on each home for complete payment. Presently there are 520 homes being submetered by 17 utilities. Two hundred fifty-seven of these homes have one year of clean usable data. The data included in the report are from these homes. The utilities may also report on water heat consumption. Some utilities, on a voluntary basis, have supplied a separate meter for measuring the energy consumption used by the water heater. 3 tabs.

14790 (DOE/BP/23821–5) **Data logger analysis case studies: Residential Construction Demonstration Project Cycle I.** Douglass, J.G.; Downey, P.K. Washington State Energy Office, Olympia, WA (USA). May 1990. 101p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC79-85BP23821. Order Number DE91009699. Source: OSTI; NTIS; GPO Dep.

A set of 12 homes with advanced heat recovery ventilation systems located in Washington, Idaho, and Montana are monitored under the Bonneville Power Administrations Residential Construction Demonstration Project. Five of the homes are equipped with exhaust air heat pumps. Two different types of EAHP systems are monitored. The first type, which is installed in three houses in Washington State, provides space and water heat and extract energy from the exhaust air stream only. These heat pumps achieved overall coefficients of performance (COP) between 3.1 and 2.5 and ventilated the homes well above the required 0.25 mechanical air changes per hour during the heating season. COP is a ratio of the energy extracted from the exhaust air and the energy required to operate the system. Total energy recovered from exhaust air by these three heat pumps ranged from 1,733 to 3,300 Btu/hr for the entire monitoring period. COP is adjusted downward due to excess ventilation. Efficiency of these systems may be increased through better system controls and operation. The second type of EAHP that is installed in two Montana homes extracted energy from both exhaust and supply air streams. These heat pumps achieved considerably lower COPs. COP for these two homes are 1.8 and 1.7. The systems are operated less often and did not provide the recommended air change rate. Seven houses are ventilated with air-to-air heat exchangers with special measures to heat supply air before delivery. Four heat exchanger systems are integrated with forced air electric furnaces of heat pumps and three systems used duct heaters to preheat incoming air. These systems saved between 162 and 1,172 Btu/hr over the entire monitoring period.

14791 (DOE/BP/23821–6) **Infiltration and ventilation in new electrically heated homes in the Pacific Northwest: Residential Construction Demonstration Project Cycle II.** Palmiter, L.; Brown, I.; Bond, T. Washington State Energy Office, Olympia, WA (USA). Feb 1991. 52p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC79-85BP23821. Order Number DE91009697. Source: OSTI; NTIS; GPO Dep.

Due to the recent emphasis by home buyers and builders on energy efficiency, tighter homes are being constructed. In the past, it was generally assumed that natural infiltration would provide adequate ventilation, but this is no longer the case in modern energy-efficient homes. This concern has led to the development of minimum ventilation standards and requirements for mechanical ventilation systems. Infiltration characteristics of homes in the Northwest have been measured in a series of research and demonstration projects sponsored by the Bonneville Power Administration (BPA). These include the Northwest Residential Infiltration Survey (NORIS) and the Residential Construction Demonstration Project (RCDP). The NORIS, Cycle 1 (NORIS 1) was intended to provide a base line for homes completed between January 1, 1980 and November 1, 1987. NORIS 2 investigated homes built to April 1987 SGC specifications. The SGC program required the NORIS 2 homes to have ventilation systems. The objective of RCDP was to increase the capacity of the new home building industry to produce cost-effective, energy-efficient housing by demonstrating new construction techniques and product innovations. Data collected from the homes provided information for decisions on resource policy and refinement of specifications. Cycle I of this project studied homes with heat-recovery ventilation systems. Under Cycle II of this project, 181 homes were constructed in the BPA service area during 1987 and 1988. In addition to incorporating RCDP innovations, the homes also had to meet the April 1987 SGC specifications, including the ventilation system requirements. Ventilation data are available on 129 of these homes. This report summarizes the ventilation- and infiltration-related aspects of the RCDP 2 project, and compares the results with those from both NORIS studies. 14 refs., 9 figs., 21 tabs.

14792 (DOE/BP/35544–1) **Development of an energy efficient desiccant dehumidifier: Final report.** Relwani, S.M. (IIT Research Inst., Chicago, IL (USA)); Moschandreas, D.J.; Thomas, O.R. IIT Research Inst., Chicago, IL (USA); Air Technology Systems, Inc., Frederick, MD (USA). Apr 1990. 129p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC79-87BP35544. Order Number DE91009690. Source: OSTI; NTIS; GPO Dep.

Humidity control in space conditioning has received a good deal of attention in the past twenty or so years. Perhaps the most familiar application is the use of humidifiers in the winter months. Of equal concern is the use of air conditions and dehumidifiers in the summer months. High humidity levels in summer months require lower coil temperatures in order to achieve human comfort levels, and may result in significant product and property damage if humidity levels are not controlled at appropriate level. This study addresses the solid desiccant dehumidifier using IR heaters as an energy efficient desiccant dehumidifier (EEDD). The study is divided into two phases: Phase 1 – Application assessment; and Phase 2: Prototype design, manufacture, and testing. Phase 1 addresses the total electrical energy usage by all possible applications of the EEDD and evaluates the energy performance of the EEDD in terms of its percentage energy savings compared to the

conventional vapor compression cooling and also with the state-of-the-art desiccant dehumidifiers. During Phase 2, a functional EEDD prototype unit was designed and manufactured. The work of Phase 2 was divided into four tasks: Task 1, conceptual design; Task 2, mechanical (blueprint) design; Task 3, manufacture and factory testing; and Task 4, performance testing. 17 refs., 21 figs., 30 tabs.

14793 (DOE/BP/60294–1) **Reflective insulation handbook.** Desjarlais, A.O.; Tye, R.P. USDOE Bonneville Power Administration, Portland, OR (USA); Holometrix, Inc., Cambridge, MA (USA). Thermatest Div. Aug 1990. 30p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AI79-86BP60294. Order Number DE91009691. Source: OSTI; NTIS; GPO Dep.

When reflective-foil insulation manufacturers wanted the Bonneville Power Administration (BPA) to include their products in the Residential Weatherization Program, they lacked conclusive test data to prove that their products met program specifications. Reflective foils lacked widespread acceptance because of uncertainty about their insulation values. BPA discovered that the Department of Energy (DOE) and Oak Ridge National Laboratory (ORNL) was preparing a study to test how well reflective foils reduced horizontal heat flow. Because the insulation value of reflective foils depends upon the direction of heat flow, BPA provided additional funding to test their effectiveness in reducing upward and downward heat flow and to produce this Handbook. The objectives of this study were to develop acceptable test and evaluation methods, produce an initial data base of idealized reflective-foil insulation systems, extend this data base to a limited number of commercially available products to develop and test analytical models to predict thermal performance and develop a Reflective Insulation Handbook for homeowners and insulation contractors. This handbook describes how heat is transferred; the function of an insulation; what reflective insulation is; types of reflective insulation; where it can be used; installation procedures; thermal performance; and useful sources of information. 10 figs., 2 tabs.

14794 (DOE/SF/18225–T1) **Weatherization Inspection Guide 1 for the Department of Energy's weatherization installers and inspectors.** Heath (Richard) and Associates, Fresno, CA (USA). Apr 1991. 22p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-89SF18225. Order Number DE91009994. Source: OSTI; NTIS; GPO Dep.

This guide provides written procedures for the post-inspection of weatherization measures under both the Low-Income Weatherization Assistance Program (DOE) and the Low-Income Home Energy Assistance Program (LIHEAP). Since the inception of the DOE program in 1976, quality of workmanship has been controlled by front end training of work crews and post-inspections by crew leaders. The subjective nature of this approach to quality assurance has obvious shortcomings. Not all installers and inspectors receive the same amount of training. Not all training programs neither adequately address the correct techniques and procedures for the proper installation of basic weatherization measures nor the correct inspection of the completed installations. The weatherization standards were written to address several of these shortcomings by providing uniform, objective, clearly written and illustrated standards for the installation of quality workmanship. The standards also serve as tools for measuring quality performance. The Inspection Guide supplements the standards and serves installers and inspectors training needs. The Inspection Guide also is an instrument for the inspection of completed dwelling units. The guide is not blower door driven and does not make use of the more advanced diagnostic technology such as tracer gases and infrared thermography. It was written to supplement those weatherization programs that utilize mandatory lists of measures and do not yet make use of this advanced technology. 19 figs.

14795 (ECN-C–90-055) **Housing stock and space heating: Developments and trends.** Bais, J.M. Netherlands Energy Research Foundation, Petten (Netherlands). Dec 1990. 42p. (In Dutch). Order Number DE91760567. Source: OSTI; NTIS (US Sales Only).

The results from the computer models WOVESTAT and WOVEGAS with regard to the development of the housing stock, space heating, gas consumption and emissions of CO_2 and NO_x are presented for the Netherlands. First a brief history of the housing construction from 1945 to the present is given as well as future developments up to 2016. This history concerns the population growth, the number of housekeepings, the number of houses to be built and the housing stock. Subsequently the developments in housing insulation are outlined. Special attention is paid to building regulations and standards. Next space heating of houses and the market for the gas-fired central heating boiler is dealt with. Finally comparative evaluations are given with regard to the aims, as stated in the Energy Conservation Bill, the results of the computer calculations and the results from the housing stock development. In the appendix the model design is described. Also an interpretation of the collected data is given. 11 figs., 21 refs., 16 tabs., 1 app.

14796 (ENET–8700187/25) **Closing report - building sanitation incentive programme 1983-1988.** Schlegel, P. (Basler und Hofmann, Ingenieure und Planer AG, Zurich (Switzerland)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Mar 1989. 54p. (In German). Order Number DE91765824. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The building sanitation incentive programme of the Federal Office of Economic Affairs was an integral part of the second incentive programme, approved by the federal legislative chambers in the autumn session of 1982, to encourage technological development and training. The promotion measures in the field of building sanitation (i.e. heating, ventilation, air-conditioning, sanitary and electrical installation) had the job of helping to close the training gaps caused by the accelerated, technical developments of the '70s and early '80s and to encourage the new energy-saving and environmentally harmless technologies. More than 15,000 specialists from the building sanitation trades, as well as from interested architects, owners of buildings and specialist teachers attended the 420 courses and events in German, French and Italian that had been held up to the spring of 1989. The total circulation of the 41 technical books and other publications in the three languages worked on as part of these events, reached almost 120,000. Such figures reflect the widespread nature of the incentives given. If the number of participants reached is compared with the estimate of the 'building sanitation analysis' at the start of the incentive programme, then it exceeds the expectations at the time considerably. figs., tabs., refs.

14797 (ENET–8700456/1) **Technical final report on NEFF-Project No. 182: ambient air as a heat source for heat pumps.** Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1990. 39p. (In German). Order Number DE91765830. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

Test results are revealed for an initial series of tests and an outline given of the reasons why the project will not be continued. 2 figs., 1 tab.

14798 (ENET–8900018/1) **Energy-technology study of a solar heat pump: P. Knuesel pilot installation, Altnau: Final report.** Forster, J. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Jul 1990. 34p. (In German). Order Number DE91765857. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The present final report shows the results of a measuring exercise at the P. Knuesel 'Solar House'. The heat requirement (heating and hot water) is guaranteed by a heat pump installation. In this, the ambient energy is extracted via an earth register and a solar collector plant. Within three different heating periods, various energy consumption data have been compiled. It is therefore possible to draw up an energy balance-sheet for the house. The combination of solar and earth collector works well. The energy yield in summer - using solar collectors - exceeds usage. The chosen surface area of the collector is too large for the single-family house. The annual output figure for the total energy requirement is covered by the solar plant. The output figure for the heat pump averages around 2.8. figs., tabs.

14799 (ENET–8900027/2) **Effect of the pitched roof construction on protection from summer heat in converted attics.** Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Aug 1990. 15p. (In German). Order Number DE91765818. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The reaction of converted attic rooms to summer climatic conditions was computer-simulated. It appeared that only heavy roof constructions have significant effect on the temperature level; the greatest influence is exerted by the inhabitants in the ventilation and shade they provide. Skylights should not be used. figs., 7 tabs., 8 refs.

14800 (ENET–8900056/2) **Efficient energy utilization in schools: Conference as part of the EFFENS research project of the BEW for planners, architects and representatives of authorities.** Bundesamt fuer Energiewirtschaft, Bern (Switzerland). May 1990. 54p. (In German). Order Number DE91765819. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

All the schools in Switzerland together, with an energy consumption area of 20 million m^2, are the largest sector of the 12 service sectors. Schools are almost exclusively public authority run and administered and are, therefore, ideal candidates for speeding up efforts to make savings and achieve efficient energy utilization. Three problems areas - light, air and regulation - still have to be investigated in depth. Schools with less than a quarter of the present, average consumption are already in operation. However, the desirable conditions for comfort still have to be defined. Conversion of the statistics from the late 70s into up-to-date energy consumption values, as well as the description of 10 models form the bases for the research activities. figs., tabs., refs.

14801 (ENET–8900091/4) **Planning of experiments to measure ventilation efficiencies.** Roulte, C.A. (Ecole Polytechniquem Federale, Lausanne (CH), Lab. d'Energie Solaire et de Physique du Batiment); Compagnon, R.; Jakob, M. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). May 1990. 32p. Order Number DE91765815. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

This document has been prepared in the frame of the Annex 18 of the IEA-ECB program: 'Demand controlled ventilation systems'. It shows how various tracer gas techniques can be applied to solve several problems encountered in ventilation technique, as the determination of the air flow rates and dependant characteristics such as air change rates, room mean age of air, etc. A special attention is given to demand controlled ventilation, where the location of the control probe is an important question. These various techniques are applied to a practical example, the Auditorium D16.2 of the Eidgenoessische Technische Hochschule Zuerich, and the various air flow rates of its balanced ventilation system are measured. It is shown that a large fraction of extracted air is recirculated into the supply air duct through the heat recovering system (rotating wheel exchanger). (author) 12 figs., tabs., 12 refs.

14802 (ENET–8900154/1) **Sorting out fundamental problems of systems for ventilating, heating and/or cooling buildings.** Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Jun 1990. 170p. (In German). Order Number DE91765823. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The present study was used to take stock of the systems for ventilating and heating and/or cooling buildings, based on research of reference literature, as well as by questioning ventilation experts, surveys amongst owners of real estate and operators of ventilation systems and through carrying out examinations of ten case studies. The results of this work form the basis of detailed system analyses, which are to be carried out in a second phase of the project (1990-91). figs., tabs., 75 refs.

14803 (ENET–8900176-1) **Evaluation of multizone air flow simulation codes using measured data: Final report.** Fuerbringer, J.M. (Ecole Polytechnique Federale, Lausanne (CH). Lab. d'Energie Solaire et de Physique du Batiment); Roulet, C.A.; Compagnon, R.; Scartezzini, J.L. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). May 1990. 399p. (In French). Order Number DE91765825. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

Any simulation program and especially a multizone infiltration simulation code shall be evaluated in such a way that its application limits are known. This document reports on the work done to make possible such an evaluation. The evaluation process follows several phases, which are described in the report: validation of the individual routines and of their assembly, sensitivity analysis of the code, empirical validation and evaluation of the user-friendliness and finally statistical evaluation. Most of the work is however experimental. The aim is to measure a set of high quality data needed for the empirical validation, which is the comparison of the results of simulations with data measured on a real building. In this work, the LESO is the building into consideration. Appropriate instruments were developped for that scope, namely a guarded zone pressurization system and a multi-tracer and flow rates measuring instrument. The resulting data set is presented partly in an annex to the present report and partly in a MS-DOS floppy disk. (author) figs., tabs., refs.

14804 (ENET–8900257/1) **LUMEN interdisciplinary research program: The natural and energy-source light of the building.** Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1989. 12p. (In French). Order Number DE91765826. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The definitive aim of this research is to provide the architect, through an interdisciplinary exercise, with the elements of knowledge and with the methodological tools necessary to master the use of natural light when designing buildings. It is a question, in particular, of reducing energy consumption, whilst at the same time guaranteeing the required conditions of visual comfort and improving the architectural quality of the interior spaces. The realisation of this objective depends upon the collaboration between three different disciplines represented by the petitioners: the architecture, the physical characteristics of the building and the visual ergonomics. 4 figs., 5 refs.

14805 (ENET–8900257/2) **State of the art of R+D into natural light in the United States.** Scartezzini, J.L. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1989. 26p. (In French). Order Number DE91765828. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

Within the framework of the EPFL's new 'Institut de Technique du Batiment' (Institute of Buildings Technology), the LUMEN research programme was introduced in early 1988 on the topic of 'Daylight'. In oder to speed up this programme, a residential study visit was made to the Lawrence Berkeley Laboratory and to the University of California, Los Angeles, in order that benefit could be drawn from the work there being conducted within this field. 12 figs., 3 refs.

14806 (ENET–8900597/1) **Improvement in the thermal characteristics of a room with direct solar energy extraction using latent heat storage: Final report NEFF-project No. 429.** Woodman, T.P. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). May 1990. 38p. (In German). Order Number DE91765858. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The objective of this study was to investigate, by means of computer-simulation, the thermal characteristics of a room with direct solar energy extraction, the inner surfaces of which are lined with latent storage material (LSM). The simulation was carried out on the basis of experimentally determined properties of LSM-plates, both an organic and a salt-hydrate store having been incorporated. The results show that the use of LSM-plates in light construction is possible for sliding partitions walls and in rooms which are left unheated when not in use and which, upon resumption of use, need to be quickly heated up, without the need to put up with large temperature fluctuations during normal running. 21 figs., tabs., 3 refs.

14807 (ENET–8990001/1) **Conference papers, 3rd status seminar, 8th November 1989: Research programme into energy-significant air currents in buildings.** Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1989. 126p. (In German). Order Number DE91765816. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The seminar gives a summary of the research work in the three areas, 'air currents in the single room', 'exchange of air and pollutants between individual zones in the building and its environment' and 'future-orientated ventilation systems'. There is also a report on cooperation with the international programmes, 'IEA annex 20: air flow pattern within buildings', 'COMIS = conjunction of multiroom infiltration specialists' and 'IEA annex 18: demand controlled ventilating systems'. figs., tabs., refs.

14808 (ENET–89006733/1) **Energy studies for a variable heating and protective element for use in the air gap of window glazings.** Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1990. 57p. (In German). Order Number DE91765855. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The present project relates to a film roll in the air gap of insulating glazing. Investigations are to be conducted to establish how the position of the film (pulled-up, let down) affects the building's energy budget, the surface temperatures of the glazing nd the thermal comfort; the results are compared with those of known window systems. figs., tabs.

14809 (EUR–12591) **Dynamic behaviour of heat pumps: an investigation of short running time.** Fordsmand, M. Commission of the European Communities, Luxembourg (Luxembourg). 1990. 24p. Contract No. EN3E-0021-DK. Source: OSTI; NTIS (US Sales Only).

We consider dutycycling of heatpumps, addressing the following subjects. First we describe a method to measure the dynamic efficiency. Secondly using the result we develop a simple model for heatpump performance when dutycycling, including a discussion of the effect of startcurrents. Finally we consider the possible application of dutycycling, and related technical problems. It is concluded that it is possible to improve the coefficient of performance of a heatpump with dutycycling with a factor of 20-30%. This however demands that the heatpump is suitable for dutycycling. That is the compressor must have low startlosses and the refrigerent circuit have a suitable large timeconstant of above 30 sec.

14810 (IVO-B–05/90) **Ceiling and radiation heating, basic physiology and evaluation of health hazards.** Valjus, J. Imatran Voima Oy (IVO), Helsinki (Finland). 1990. 30p. (In Finnish). Order Number DE91763449. Source: OSTI; NTIS (US Sales Only).

In comfortable indoor environment about 15% of the heat produced by metabolic processes is transferred to the environment via evaporization of water on respiratory tract. About 85% the heat transfer is divided equally between convection and radiation. It is obvious that if in ceiling heating the surface temperature of a ceiling is high (over 37 deg C) this can locally decrease the proportion of heat radiation at least on head area which is an important heat emitting surface. A ceiling heating with low (30-35 deg C) surface temperature can be considered more physiological than a ceiling heating with higher surface temperature. If the infrared (IR) radiant flux density of a ceiling heating or low-temperature radiant heater does not exceed the safety recommendation of 100 W/m^2 mentioned in literature, it is difficult to find even theoretical health risks which can bring discredit on these heating systems. Middle- and high-temperature radiant heaters emit IR-B and at about 600 deg C start to emit also IR-A wavelengths which in theory may have effects on the skin and the eyes. In practice there may be a possibility of skin disorders mainly amoung people with diseases causing photosensivity, and eye disorders in the case of simultaneous long-term exposure to both short wave IR radiation and blue visible light. The safety recommendation of 100 W/m^2 IR radiant flux density mentioned above can be applied also here.

14811 (KTM/E-D–184) **Demand controlled ventilation in industrial painting workshops.** Yrjoelae, J. (PI-CONSULTING LTD, Helsinki (Finland)); Olkinuora, J.; Lehtimaeki, M.; Saeaemaenen, A. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1990. 170p. (In Finnish). Project KTM-230/881/87. Order Number DE91763439. Source: OSTI; NTIS (US Sales Only).

In earlier work, it was discovered that traditional ventilation methods for industrial painting operations tended to provide much more ventilation that was necessary. Demand controlled ventilation seems to be a viable alternative to traditional ventilation methods. Some speculations about the usability of the technology used for the time being has been made by the occupational hygienists. This experimental study examined the possibilities, the overall effects and energy savings of demand controlled ventilation for industrial painting operations. On-site measurements (two pilot plants) were made to test the possibilities, the overall effects and potential energy savings. The tested systems were: regulation of ventilation according to solvent concentrations in the air of working facilities, regulation systems connected with spray guns and no regulation (constant maximum air flow). The biggest problem was the long delay time due to many components of the controlling system. A simulation model/program was made, which allows the theoretical prediction of solvent concentrations by given facts about ventilation, production etc. The results of the simulation were verified by on-site measurements and the final result was that the starting signal must be taken from the concentration source itself, in other words, from the spraying gun. Air-quality sensors could be used to supervise the solvent concentration not to rise up to the threshold limit values.

14812 (LBL–26950) **Sources and source strengths of volatile organic compounds in a new office building.** Hodgson, A.T. (Lawrence Berkeley Lab., CA (USA)); Daisey, J.M.; Grot, R.A. Lawrence Berkeley Lab., CA (USA). Oct 1990. 18p. Sponsored by USDOE, Washington, DC (USA); General Services Administration, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-890692–25: 82. Air and Waste Management Association annual meeting and exhibition, Anaheim, CA (USA), 25-30 Jun 1989). Order Number DE91009328. Source: OSTI; NTIS; GPO Dep.

This study was conducted at a newly constructed Federal office building in Portland, OR. The primary objectives were to identify the major sources of volatile organic compounds (VOC) in the building and to measure both long-term (one-year) and short-term (several day) variations in source strengths. Samples for VOC were collected on four occasions over a period of 14 months starting with the first month of occupancy. During the final sampling period, samples were collected over four days (Friday–Monday). The samples were analyzed for individual compounds and for total VOC (TVOC). The results were expressed as specific source strengths, as well as concentrations, to facilitate comparisons of measurements made under different ventilation conditions. The primary source of VOC in the building was identified as liquid-process photocopiers and plotters which emitted a characteristic mixture of C_{10}–C_{11} isoparaffinic hydrocarbons. The specific source strength of TVOC, which was dominated by the office-machine emissions, remained relatively constant over the course of study. During the final four-day sampling period, the specific source strength of TVOC varied by about a factor of six with occupancy. The source strengths of many other compounds during those four days were also related to occupant activities. Motor vehicles in the below-ground parking garage were implicated as another major source of hydrocarbons in the building. 12 refs., 7 figs., 2 tabs.

14813 (LBL–29610) **Dynamic simulation of a liquid desiccant cooling system using the Energy Kernel System.** Nataf, J.-M.; Winkelmann, F. Lawrence Berkeley Lab., CA (USA). Feb 1991. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010273. Source: OSTI; NTIS; GPO Dep.

The Energy Kernel System (EKS) is a simulation environment for building energy analysis under development at Lawrence Berkeley Laboratory. EKS is a very flexible, highly modular environment that allows users to create customized models of thermal systems by linking together calculation objects - either defined by the user or obtained from a library - that describe the individual components of the system. A principal departure from other simulation environments is that system models are constructed from submodel objects that are defined without prescribed input or output interfaces, yielding greater modeling flexibility. Also, graph theoretic techniques are employed to determine the solution sequence, including reduction of the iterative problem size at each time step. To demonstrate the use of EKS for modeling complex physical systems, the authors present in this paper a dynamic EKS simulation of a hybrid liquid desiccant cooling system. They show (1) how EKS calculation objects are generated automatically using MACSYMA (MIT, 1983), given the basic algebraic and differential equations for the system; (2) how EKS objects are linked into macro objects that describe system components; and (3) how macro objects are linked together to form a mathematical network representing the entire system. Finally, they show graphically the numerical results of running a time-dependent simulation of the system. 11 refs., 6 figs.

14814 (LBL–29678) **Energy efficiency and household electric appliances in developing and newly industrialized countries.** Meyers, S. (Lawrence Berkeley Lab., CA (USA)); Tyler, S.; Sathaye, J.; Schipper, L.; Geller, H. Lawrence Berkeley Lab.,

CA (USA). Dec 1990. 76p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010225. Source: OSTI; NTIS; GPO Dep.

This report presents data and analysis concerning household electric appliances in developing countries. Electricity demand for household appliances is an important source of growth in peak electricity demand in many countries. The authors illustrate how diffusion of appliances is growing rapidly in many countries, and describe basic characteristics of appliances, including their energy efficiency. They present evidence that energy efficiency of new appliances is typically very low relative to average technology levels in the industrialized countries. They discuss technical options for improving appliance efficiency, and show that improving appliance efficiency is likely to be very beneficial for developing countries. They discuss how the appliance market and the appliance industry affect the level of efficiency that is incorporated in new appliances, and conclude that significant improvement in appliance efficiency is unlikely to occur in most countries without government involvement. They discuss strategies for improving appliance efficiency, and conclude that working with appliance manufacturers is likely to yield faster and larger results than providing incentives for consumers. Establishment of testing programs for key appliances such as refrigerators and air conditioners is an important first step for assessing the energy efficiency of new appliances and measuring progress in increasing efficiency. 31 refs., 3 figs., 16 tabs.

14815 (NEI-DK–505, pp. 1-86) **Individual natural gas-fired heating systems in the year 2000: Building group's review.** Dansk Teknologisk Inst., Taastrup (Denmark). Energiteknologi. Nov 1990. 183p. (In Danish). Contract EM-1323/88-20. In *Individual natural gas-fired heating systems in the year 2000.* Order Number DE91763412. Source: OSTI; NTIS (US Sales Only).

EFP-88.

The report constitutes a part of the preparatory work in connection with the project "Individual natural gas-fired heating systems in the year 2000". The "building group" elucidates which demands the natural gas systems of the future should fulfill in relation to heating efficiency with regard to expected improvements in thermal insulation of villas and terrace houses in Denmark. (AB).

14816 (NEI-FI–128) **Balancing of radiator network.** Kaerkkaeinen, A. (Tekno-Innovaatio Oy, Turku (Finland)); Hoerkkoe, J. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1988. 60p. (In Finnish). Project KTM-81/881/85. Order Number DE91763437. Source: OSTI; NTIS (US Sales Only).

The aim of the present study was to develop a computer-based method for carrying out reliable basic adjustment of a water radiator network. Software was developed on the basis of practical applications to provide a functional tool for this purpose. The calculation of flow and heat emission in the network takes into account factors that are not normally included. Such factors are, for example, the cooling of outflowing water in uninsulated pipes and the effect of gravity water circulation. Furthermore, the study considers in detail the significance of the various factors for the final result. Flow and heat emission in heat distribution networks can be calculated with sufficient accuracy for making the basic adjustments. This does not, however, always apply to the calculating of space heating requirements, which provide the basis for calculating the amount of water required in radiators. Thus final data on the actual heating requirement of each room are obtained by carrying out a test measurement in winter conditions. If the measurement gives results that deviate from the desired temperatures, the software makes it possible to calculate new adjustment values for the radiator valves in each room utilizing the measured values and data already fed into the computer. The values for balancing valves are also changed at the same time.

14817 (NEI-SE–64) **Efficient and low energy demanding ventilation in foundries.** Holmgren, M. Svenska Gjuteriföreningen, Joenkoeping (Sweden). Jun 1990. 67p. (In Swedish). Order Number DE91763542. Source: OSTI; NTIS (US Sales Only).

Generally speaking the ventilation in Swedish foundries does not work properly. Of the total energy consumption in a foundry 25-30% is devoted to heating ventilation air. To reach a more efficient ventilation and at the same time lower the cost of electric power for the ventilation this project was initialized. Visits to around 20 foundries have shown the low priority given to the function and quality of the ventilation systems. In this report a couple of different measures to cope with this situation are described and three industries have been chosen for case studies. (U.W.).

14818 (NUREG/CP–0116-Vol.2) **Proceedings of the 21st DOE/NRC nuclear air cleaning conference: Volume 2, Sessions 9–16.** First, M.W. (ed.) (Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab.). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. Feb 1991. 480p. Sponsored by USDOE, Washington, DC (USA); Nuclear Regulatory Commission, Washington, DC (USA). (CONF-900809–Vol.2: 21. DOE/NRC nuclear air cleaning conference, San Diego, CA (USA), 13-16 Aug 1990). Source: OSTI; NTIS; INIS; GPO.

The 21st meeting of the Department of Energy/Nuclear Regulatory Commission (DOE/NRC) Nuclear Air Cleaning Conference was held in San Diego, CA on August 13–16, 1990. The proceedings have been published as a two volume set. Volume 2 contains sessions covering adsorbents, nuclear codes and standards, modelling, filters, safety, containment venting and a review of nuclear air cleaning programs around the world. Also included is the list of attendees and an index of authors and speakers. (MHB)

14819 (ORNL/M–1410) **Buildings sector field program planning workshop: Proceedings.** Oak Ridge National Lab., TN (USA). 22 Mar 1991. 77p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. (CONF-910194–Summ.: Buildings sector field program planning workshop, Oak Ridge, TN (USA), 29-31 Jan 1991). Order Number DE91010240. Source: OSTI; NTIS; GPO Dep.

On January 29–31, 1991, 20 buildings research managers representing 8 national laboratories met in Oak Ridge, Tennessee, for the Buildings Sector Field Program Planning Workshop. The purpose of the Workshop was to provide the Office of Conservation and Renewable Energy (CE) with input from a coordinated field laboratory effort for the CE FY 1993 budget and planning process. Participants at the Buildings Sector Workshop reviewed the nine existing programs of the Office of Building Technology (OBT) at the key activity level and discussed a large number of initiatives that were new relative to the FY 1991 program. The 9 programs are as follows: Solar technologies; Materials and structures; Lighting and appliances; Heating and cooling equipment; Indoor air quality; Building systems; FEMP; Implementation and development; and Management. Participants did not suggest any changes in the number or names of OBT programs. However, modifications to incorporate new activities were suggested in all cases except for the Management Program.

14820 (ORNL/Sub–86-24610/1) **Development of a high-efficiency, gas-fired, absorption heat pump for residental and small-commercial applications: Phase 1, Final report: Analysis of advanced cycles and selection of the preferred cycle.** Phillips, B.A. (Phillips Engineering Co., St. Joseph, MI (USA)). Oak Ridge National Lab., TN (USA); Phillips Engineering Co., St. Joseph, MI (USA). Sep 1990. 68p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010442. Source: OSTI; NTIS; GPO Dep.

The purpose of the total project is to develop a gas-fired absorption heat pump for residential and small-commercial applications that will produce at least 1.6 Btu of heating and 0.7 Btu of cooling per Btu of heat content in the gas being burned. The primary technology advances that can be used to attain the new goals are higher efficiency cycles, increased flue efficiency, and better fluids. Flue efficiency technology is well developed, and fan-assisted combustion systems with condensing heat exchangers can limit flue and insulation losses to the 10% range. If this 10% loss assumption is made, the resulting target cycle COPs are 1.78 in heating mode and 0.78 in cooling mode at the ARI rating conditions. The objective of Phase 1 was to analyze working fluids and absorption-cycle concepts that are capable of performing at the target COPs and are potentially competitive with existing space-conditioning products in cost, operating life, and reliability. Six advanced cycles were evaluated with ammonia/water as the fluid pair. Then additional analysis was performed with other fluid pairs to determine whether cycle ranking would change depending on which fluid was used. It

was concluded that the preferred cycle/fluid was the generator-absorber heat exchange (GAX) cycle using ammonia/water as the fluid pair. A cost estimate made by an independent manufacturing engineering firm for a residential heat pump based on the cycle/fluid combination determined that the GAX heat pump could be cost competitive with existing products. 20 refs., 28 figs., 2 tabs.

14821 (ORNL/TM–1391) **Building Thermal Envelope Systems and Materials (BTESM): Progress report for DOE Office of Buildings Energy Research.** Burn, G. (comp.). Oak Ridge National Lab., TN (USA). Feb 1991. 37p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010380. Source: OSTI; NTIS; GPO Dep.

The Monthly Report of the Building Thermal Envelope Systems and Materials (BTESM) Program is a monthly update of both in-house ORNL projects and subcontract activities in the research areas of building materials, wall systems, foundations, roofs, and building diagnostics. Presentations are not stand-alone paragraphs every month. Their principal values are the short-time lapse between accomplishment and reporting and their evolution over a period of several months.

14822 (PNL–6659) **Significant ELCAP analysis results: Summary report: End-Use Load and Consumer Assessment Program.** Pratt, R.G. (Pacific Northwest Lab., Richland, WA (USA)); Conner, C.C.; Drost, M.K.; Miller, N.E.; Cooke, B.A.; Halverson, M.A.; Lebaron, B.A.; Lucas, R.G.; Jo, J.; Richman, E.E.; Sandusky, W.F.; Ritland, K.G.; Taylor, M.E.; Hauser, S.G. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 161p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009156. Source: OSTI; NTIS; GPO Dep.

The evolution of the End-Use Load and Consumer Assessment Program (ELCAP) since 1983 at Bonneville Power Administration (Bonneville) has been eventful and somewhat tortuous. The birth pangs of a data set so large and encompassing as this have been overwhelming at times. The early adolescent stage of data set development and use has now been reached and preliminary results of early analyses of the data are becoming well known. However, the full maturity of the data set and the corresponding wealth of analytic insights are not fully realized. This document is in some sense a milestone in the brief history of the program. It is a summary of the results of the first five years of the program, principally containing excerpts from a number of previous reports. It is meant to highlight significant accomplishments and analytical results, with a focus on the principal results. Many of the results have a broad application in the utility load research community in general, although the real breadth of the data set remains largely unexplored. The first section of the document introduces the data set: how the buildings were selected, how the metering equipment was installed, and how the data set has been prepared for analysis. Each of the sections that follow the introduction summarize a particular analytic result. A large majority of the analyses to date involve the residential samples, as these were installed first and had highest priority on the analytic agenda. Two exploratory analyses using commercial data are included as an introduction to the commercial analyses that are currently underway. Most of the sections reference more complete technical reports which the reader should refer to for details of the methodology and for more complete discussion of the results. Sections have been processed separately for inclusion on the data base.

14823 (PNL–6778-Vol.1) **Evaluation of the near-term commercial potential of technologies being developed by the Office of Building Technologies: Volume 1, Screening of technologies.** Weijo, R.O. (Portland General Electric Co., OR (USA)); Nicholls, A.K.; Weakley, S.A.; Eckert, R.L.; Shankle, D.L.; Anderson, M.R.; Anderson, A.R. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 71p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009744. Source: OSTI; NTIS; GPO Dep.

This project developed an inventory of the Office of Building Technologies (OBT) from a survey administered in 1988 to program managers and principal investigators from OBT. Information provided on these surveys was evaluated to identify equipment and practices that are near-term opportunities for technology commercialization and to determine whether they needed some form of assistance from OBT to be successful in the marketplace. The near-term commercial potential of OBT technologies was assessed by using a technology selection screening methodology. The screening first identified those technologies that were ready to be commercialized in the next two years. The second screen identified the technologies that had a simple payback period of less than five years, and the third identified those that met a current need in the marketplace. Twenty-six OBT technologies met all the criteria. These commercially promising technologies were further screened to determine which would succeed on their own and which would require further commercialization support. Additional commercialization support was recommended for OBT technologies where serious barriers to adoption existed or where no private sector interest in a technology could be identified. Twenty-three technologies were identified as requiring commercialization support from OBT. These are categorized by each division within OBT and are shown in Table S.1. The methodology used could easily be adapted to screen other DOE-developed technologies to determine commercialization potential and to allocate resources accordingly. It provides a systematic way to analyze numerous technologies and a defensible and documented procedure for comparing them. 4 refs., 7 figs., 10 tabs.

14824 (PNL–6778-Vol.2) **Evaluation of the near-term commercial potential of technologies being developed by the Office of Building Technologies: Volume 2, Survey results.** Weijo, R.O. (Portland General Electric Co., OR (USA)); Nicholls, A.K.; Weakley, S.A.; Eckert, R.L.; Shankle, D.L.; Anderson, M.R.; Anderson, A.R. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 213p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009821. Source: OSTI; NTIS; GPO Dep.

This report consists of the results from each Equipment and Practice Form completed by the program managers and principal investigators. Information collected from the Equipment and Practice Form include the following: name and description of the technology; energy characteristics; when the technology will be ready for commercialization; estimated payback period; market sectors that would benefit; important commercialization barriers to overcome; energy-related benefits; and non-energy benefits of the technology to customers. Some of these technologies include: heat pumps, heat exchangers, insulation lighting systems; cooling systems, ventilation systems, burners, leak detection systems, retrofit procedure, operating and maintenance procedures, wall systems, windows, sampling equipment, measuring methods and instruments, thermal analysis methods, and computer codes.

14825 (PNL–7519) **Local entropy generation analysis.** Drost, M.K.; White, M.D. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 63p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91008428. Source: OSTI; NTIS; GPO Dep.

Second law analysis techniques have been widely used to evaluate the sources of irreversibility in components and systems of components but the evaluation of local sources of irreversibility in thermal processes has received little attention. While analytical procedures for evaluating local entropy generation have been developed, applications have been limited to fluid flows with analytical solutions for the velocity and temperature fields. The analysis of local entropy generation can be used to evaluate more complicated flows by including entropy generation calculations in a computational fluid dynamics (CFD) code. The research documented in this report consists of incorporating local entropy generation calculations in an existing CFD code and then using the code to evaluate the distribution of thermodynamic losses in two applications: an impinging jet and a magnetic heat pump. 22 refs., 13 figs., 9 tabs.

14826 (PNL–7659) **A tool for estimating the mix of energy conservation measures given competing acquisition scenarios.** Schultz, R.W. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 45p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009681. Source: OSTI; NTIS; GPO Dep.

Bonneville Power Administration (BPA) is conducting analyses that are to serve the Resource Program Environmental Impact Statement (RP/EIS). Parts of the RP/EIS are to address the impacts of commercial sector electricity conservation acquisitions under various conservation acquisition alternatives. These impacts include the energy conservation measure (ECM) mix adopted by the commercial sector and the equipment/technology that would be replaced by implementing new ECMs. The goal of this project was to develop a tool that has the capability to detail region-wide numerical estimates of the commercial sector ECM and replaced technology mix. The tool (hereafter called ECMMIX) was to be sufficiently flexible and user friendly that analysts could easily perform sensitivity tests of alternative forecasts of energy conservation acquisitions. It needed to have the capability to assess impacts across different building types, utility regions, vintage and end-use categories, as well as to aggregate similar ECMs across all categories. The aggregation capability was to exist for the replaced technology as well. Chapter 2 presents specific details about the methodology and assumptions adopted in developing ECMMIX. Included is a discussion of data disaggregation, adjustment to forecasted savings estimates, and incorporation of ADM and Ecotope ECMs. Chapter 3 contains a users guide to ECMMIX and concluding comments. 14 refs., 3 tabs.

14827 (SERI/TP–253-4124) **Non-CFC vacuum alternatives for the energy-efficient insulation of household refrigerators: Design and use.** Potter, T.F.; Benson, D.K. Solar Energy Research Inst., Golden, CO (USA). Jan 1991. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-83CH10093. (CONF-9105155–1: 42. international appliance technology conference, Madison, WI (USA), May 1991). Order Number DE91002131. Source: OSTI; NTIS; GPO Dep.

Energy efficiency, environmental issues, and market incentives all encourage government and industry to continue work on thin-profile vacuum insulations for domestic refrigerators and freezers (R/Fs). Vacuum insulations promise significant improvement in thermal savings over current insulations; the technical objective of one design is an R-value of better than 10 (hr-ft^2-F/Btu) in 0.1 in. thickness. If performance is improved by a factor of 10 over that of CFC-blown insulating foams, the new insulations (made without CFCs or other potentially troublesome fill gases) will change the design and improve the efficiency of refrigerators. Such changes will meet the conservation, regulatory, and market drivers now strong in developed countries and likely to increase in developing countries. Prototypes of various designs have been tested in the laboratory and in factories, and results to date confirm the good thermal performance of these thin-profile alternatives. The next step is to resolve issues of reliability and cost effectiveness. 34 refs., 4 figs.

14828 (STEV-VP–91-1) **Sorption/Compression heat pump: Final report.** Torstensson, H. (Studsvik Energy, Nykoeping (SE)); Nowacki, J.E. Statens Energiverk, Stockholm (Sweden); Studsvik Energy, Nykoeping (Sweden). Mar 1990. 43p. (In Swedish). Project STEV-656-065. (STUDSVIK-ED–89-42). Order Number DE91763557. Source: OSTI; NTIS (US Sales Only).

By utilizing the sorption/compression principle in a heat pump it is theoretically possible to reach considerably higher heating coefficients at lower process pressure than is possible with conventional heat pumps. Furthermore, freon is replaced with ammonia/water as working fluids, with no deleterious effect on the ozone layer. The aim of the project was to demonstrate a small operating sorption/compression heat pump of a very simple construction. Results obtained shows that the process is functioning as planned with a higher heating coefficient than corresponding freon heat pump. The aggregate yields a heating effect of 1.4 kW and produces 60 degree C hot water. (authors).

14829 (STEV-VP–91-2) **Peltier heat pumps.** Torstensson, H. (Studsvik Energy, Nykoeping (SE)). Statens Energiverk, Stockholm (Sweden); Studsvik Energy, Nykoeping (Sweden). Jun 1990. 61p. (In Swedish). Project STEV-656-065. (STUDSVIK-ED–90-27). Order Number DE91763558. Source: OSTI; NTIS (US Sales Only).

Todays Peltier devices in heat pump applications gives a low coefficent of performance. A temperature difference of 40 deg C results in a COP-value of approx. 1.3. Peltier devices are manufactured of alloys composed of heavy elements like tellurium, selenium, bismuth and antimony. These elements thermoelectrical properties, figure of merit are decisive to the performance of the Peltier devices. An upper limit for the figure of merit, ZT, is said to be 2, which at ΔT=40 deg C would yield a COP of 2.0 as a maximum. Organic compounds have been investigated with regard to the electric conductivity. Thin film technique have been used for Peltier devices in micro-scale. There are no large-scale applications. The method does not give enhanced termoelectrical properties, but more rational and cheaper manufacturing. (author) (47 refs., 26 figs.).

14830 (VTT-TIED–1135) **Finnish cold climate building technology and community development: Report 9. Heating and air conditioning in Finland.** Nyman, M. (ed.). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). May 1990. 73p. (In Finnish). Order Number DE91763457. Source: OSTI; NTIS (US Sales Only).

The report describes heating, piping and air conditioning (HPAC) techniques in the Finnish cold climate building technology. Main features of Finnish climate and it's influence on HPAC-techniques is being presented. High quality demands for the Finnish indoor air quality is being described and quality standard principles are introduced. Special solutions required in cold climate are discussed in details as well as via demonstrative examples. The Finnish energy economy is being described briefly. Reasons for low energy consumption in Finnish buildings in spite of the severe climate are given. HPAC-line of business in Finland is also being briefly presented. A list of needs for research and development in the field of HPAC is included in the report.

14831 (VTT-TUTK–705) **Numerical prediction of room air flows.** Heikkinen, J. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). LVI-tekniikan Laboratorio). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Aug 1990. 88p. (In Finnish). Order Number DE91763453. Source: OSTI; NTIS (US Sales Only).

To solve the flow equations it is necessary to adopt empirical turbulence models, which diminish the physical realism of the simulation. In this study the background to the k-epsilon model, Reynolds stress model and the algebraic stress model are reviewed. The applicability of these models to room-air jets and boundary layers are examined with literature and also by our own simulations. In room-air flows the low-Reynolds-number modification in the turbulence model is often necessary. Forced convection wall functions are unsuitable for heat transfer calculations in free and mixed convection. An alternative is to use to low-Reynolds-number turbulence model and at the same time, to use a fine-meshed calculation grid. An increase in simulation costs is inevitable. Another possibility is to give the convection heat flux as the boundary condition for the energy equation. Well functions tailored for free convection may also be possible. The boundary conditions at the supply-air opening are also examined. In the experimental part of the study, the velocity profiles produced by a commercial supply-air terminal are measured. These velocities are used as a boundary condition in the numerical simulation. The procedure proved to be feasible, but was rather laborious. Additional research is still required to give instructions on necessary supply air device information for use in numerical air flow simulations. The air flow field in the test room was similar to the simulated one, though the air speed was lower in the simulations. The difference can be partly explained by the uncertainty of the measurements. The difficulties in measuring low air speeds give an advantage to simulations over full-scale measurements.

14832 Low-frequency electromagnetic induction heater. Iguchi, A. 25 Sep 1990. Filed date 16 Feb 1990. Canada Patent patent application 2010204. 25p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

An electromagnetic induction heater is disclosed in which the temperature difference between a heating part and a material to be heated is small, operational reliability is high, and heating is stable over a long period. The heater comprises at least an iron core and an induction coil formed around this core, and a metal pipe formed around the iron core and induction coil. A resinous molding compound is filled between the induction coil and the surrounding

metal pipe so that any substantial gap between a surface of induction coil and a surface of metal pipe is excluded. Preferably, the low-frequency current power source is in a commercial frequency range, the metal pipe is an assembled pipe consisting of at least 2 layers of metal pipes, the resinous molding compound is formed of a resin having a high thermal resistivity, and the electric power supplied to the metal pipe surface is larger than 3 W/cm^2. Examples of effective application of the heater of the invention include domestic water heating and heating of industrial solvents. 9 figs.

14833 Heating window. Fremaux, J.; Brechot, R. 23 Sep 1990. Filed date 22 Mar 1990. Canada Patent patent application 2012886. 16p. (In French). Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A system is disclosed for transforming traditional windows into heating windows by equipping them with an additional interior glazing provided with a heating means. The heating is advantageously performed by an electrical resistance bound to the surface of the additional glazing. The resistance may consist of a transparent coating of a semiconductor metal oxide, such as tin oxide doped with fluorine and indium oxide layers doped with tin. The window of the invention is fitted with upper and lower openings which allow exterior air to enter the lower part of the inner space between the glazings and leave the upper part of the inner space into the space to be heated, the exterior air being heated during its passage through the inner space by the electrical resistance layer. 4 figs.

14834 Device for mounting insulating double-glazing onto a fixed frame. Massarelli, L.; Sampaolesi, R. 15 Sep 1990. Filed date 12 Mar 1990. Canada Patent patent application 2011991. 13p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A device for mounting double glazing onto a fixed frame is formed by two distinct members. The first member is bonded to the double glazing, the second is secured to the frame by mechanical means, and the two are coupled together by a pivotal connection. The pivotal connection prevents structural stress or external pressure applied on the sheets of glass from being transmitted to the spacer in the insulating glass, the weakest point of the system. This extends the durability of the insulating glass by preventing breakage of the first sealant and consequent moisture seepage which would result in irreversible damage to the glass and possibly detachment of the outer sheet. A further advantage of the invention is that a considerably lower quantity of structural sealant is required for installation, since the sealant is applied only along the outer periphery of the glazing. 2 figs.

14835 Improvements in and relating to heating. Jones, K.; Walker, G.D. 10 Jul 1990. New Zealand Patent priority 227186;CA patent application 2004553. 15p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

This invention relates particularly to improvements in fireboxes for solid fuel heating means, such as baffled stoves or Scandinavian stoves. The baffles in such stoves have the effect of lengthening a flow-path of gas through the firebox during combustion, and preferably to enable the firebox to provide the characteristics of efficient combustion. The invention has the object of overcoming certain disadvantages of known stoves of this type, including the sporadic or low extent of secondary or subsequent combustion when in a banked-down state, overcycling in which heat output varies considerably, and inadequate supporting of refractory materials in a baffle area. According to the invention, the baffle is made of material having a thermal conductivity lower than remaining portions of the firebox of the stove and is a panel, preferably of ceramic material, supported by at least part of its periphery adjacent opposite side portions of the firebox. This reduces or avoids problems of the baffle or its supporting structure acting as a heat sink and problems of leakage past the baffle. 3 figs.

3202 Transportation

Refer also to citation(s) 14872, 14877, 14878, 15035

14836 (ORNL/TM–11648) **Radioluminescent (RL) lighting system development program: Final report, October 1, 1987–March 31, 1989.** Haff, K.W.; Pruett, D.J.; Ramey, D.W.; Schultz, F.J.; Tompkins, J.A. Oak Ridge National Lab., TN (USA). Mar 1991. 39p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91009743. Source: OSTI; NTIS; GPO Dep.

The Oak Ridge National Laboratory (ORNL) has been actively engaged in the development of radioluminescent (RL) lights for the past 10 years. Primary emphasis of the program at ORNL has been on the development and improvement of gas-tube technology lights that have been manufactured by private industry for over 30 years. The primary use of these lights until this time has been "exit" signs with some small numbers of applications in other areas. The goal of the ORNL program has been to improve the light output and brightness of the lights to an acceptable level for use as airfield marker signs, runway lights, and taxiway lights. This goal has been achieved in that a greater than 100% light output has been obtained in commercial lights purchased for the US Air Force (USAF)and for the State of Florida. This paper presents the results of the radioluminescence tests for tritiated titanium. 12 refs., 8 figs., 2 tabs.

3203 Industrial and Agricultural Processes

Refer also to citation(s) 14001, 14003, 14005, 14028, 14039, 14134, 14395, 14486, 14695, 14745, 14832, 14944, 15029, 15256, 15355, 15356, 15357, 15358, 15359, 15360, 15361, 15362

14837 (BNL–45904) **Efficiency study of oil cooling of a screw compressor.** Tree, D.R. (Purdue Univ., Lafayette, IN (USA). Ray W. Herrick Labs.); McKellar, M.G.; Fresco, A. Brookhaven National Lab., Upton, NY (USA). [1990]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9007177–1: USNC/IIR Purdue refrigeration conference and the ASHRAE Purdue CFC conference, West Lafayette, IN (USA), 17-20 Jul 1990). Order Number DE91009434. Source: OSTI; NTIS; GPO Dep.

One of the major goals of all compressor manufacturers is to design and build as efficient a compressor as possible. In a screw compressor it appears that the way the compressor is cooled can have an effect on the compressor's efficiency. This paper presents experimental data on three different screw compressor cooling methods: Liquid Refrigerant Injection Cooling System; Thermosyphon Cooling System; and Oil Injection System. All tests were conducted on a hot gas bypass system using refrigerant R-22. The data taken shows that the Oil Injection System is slightly better than the other two. These tests should be repeated with a higher oil flow rate and ammonia as the working fluid. 10 figs.

14838 (CONF-871008–1) **A plan for implementation of innovative hazardous waste minimization techniques at an eastern US Naval Plating Shop.** Walker, J.F. Jr.; Villiers-Fisher, J.F.; Brown, C.H. Jr. Oak Ridge National Lab., TN (USA). [1987]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From Annual conference of the Water Pollution Control Federation; Philadelphia, PA (USA); 4-8 Oct 1987. Order Number DE91009647. Source: OSTI; NTIS; GPO Dep.

Oak Ridge National Laboratory (ORNL) was contracted by the Naval Energy and Environmental Support Activity (NEESA) to analyze the wastewater problems at a Naval Ordnance Station (NOS) plating shop in the eastern United States to recommend innovative wastewater treatment technologies for handling those problems and to implement the recommended treatment technology. Hexavalent chromium was identified as the major problem area at NOS. Water conservation measures were recommended which would reduce the volume of chromium-contaminated wastewater from approximately 300 L/min to approximately 20 L/min. A treatment scheme consisting of RO followed by evaporation of the RO concentrate steam was recommended. Paint-stripping operations at NOS potentially contaminate the wastewater with phenol, trichloroethane, and possibly other organics. However, the need for

a treatment unit for removal of organics could not be established due to a lack of organic analytical data. A characterization study was therefore recommended for the NOS plating shop. If treatment for organics is necessary, the treatment unit might include two-stage filtration for removal of paint flakes or other solids, air stripping for removal of volatile organics, and carbon adsorption for removal of residual organics. 7 refs., 6 figs., 3 tabs.

14839 (CONF-910636–1) **Experimental study of the effects of alcohol additives in lithium bromide water pool absorbers.** Elkassabgi, Y. (Texas A and I Univ., Kingsville, TX (USA). Dept. of Mechanical Engineering); Perez-Blanco, H. Oak Ridge National Lab., TN (USA). [1990]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From ASHRAE summer meeting; Indianapolis, IN (USA); 22-26 Jun 1991. Order Number DE90016034. Source: OSTI; NTIS; GPO Dep.

It is well known that interfacial turbulence enhances the transport of mass across vapor-liquid or liquid-liquid interfaces. In absorption heat pumps and air conditioners, mass transfer processes occur in the absorber and in the generator. The coefficients of performance and capacities of these machines depend in large part on the efficiency of the absorber component of the cycle. It is common practice to include chemical additives in the charge of these machines. Some additives control corrosion, and others enhance heat and mass transfer in the absorber size. Compared with other enhancement techniques, additives are one of the most cost-effective ways to increase absorber capacity. Although the effectiveness of some additives is beyond doubt the degree to which they are effective, the time period within which they remain effective, and the reasons for their positive effect on absorber performance are not well established. Two possible explanations for this state of affairs are that the data presented in the literature are few and that the effects of some important parameters are not systematically studied. The objective of this work is to investigate the effects of some of these parameters, such as how the initial concentration of the LiBr solution affects the mass absorption, and how four alcohol additives affect absorption enhancement. 4 refs., 6 figs.

14840 (DOE/CE/40748–T1) **Advanced sensor development program for the pulp and paper industry: Final report.** Allen, J.D.; Charagundla, S.R.; Macek, A.; Semerjian, H.G.; Whetstone, J.R. National Inst. of Standards and Technology, Washington, DC (USA). Center for Chemical Engineering. Oct 1990. 90p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AI01-85CE40748. Order Number DE91007688. Source: OSTI; NTIS; GPO Dep.

This report describes experimental and theoretical studies toward development of a remote sensing technique for non-intrusive temperature measurement based on optical spectroscopic analysis of recovery boiler. The overall objectives were (a) construction of a fiber-optic system for measurement of spectroscopic emission intensities at several wavelengths and (b) development of a computer program relating these intensities to temperatures of the emitting species. The emitting species for temperature measurements in flames can be either naturally occurring free radicals (OH, CH, C_2) or atoms which, in turn, can be either naturally occurring or seeded into flames. Sodium atoms, the obvious emitters in recovery boilers, are not promising as thermometric species because of their high concentration. At high concentrations, strong self-absorption results cause optical depths to be much smaller than the sampling depths desired for recovery boilers. An experimental program was, therefore, undertaken with the objective of identification and spectroscopic detection and measurement of other naturally occurring thermometric species. The program consisted of several laboratory studies and four field trips to different recovery boilers. 19 refs., 43 figs., 8 tabs.

14841 (DOE/ID/12826–1) **Research and development of industrial drying concepts using a superheated steam atmosphere with exhaust recompression: Phase 1, Final report, October 1989–December 1990.** Dibella, F.A.; Doyle, E.F.; Becker, F.E.; Lang, R. TECOGEN, Inc., Waltham, MA (USA). Jan 1991. 270p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC07-89ID12826. (TR–7020-009-91). Order Number DE91009987. Source: OSTI; NTIS; GPO Dep.

For the thermal drying processes where water is to be removed via evaporation from the feedstock, attempts have been made to reduce the consumption of energy using exhaust waste heat recovery techniques, improved dryer designs, or even the deployment of advanced mechanical dewatering techniques. Despite these efforts, it is obvious that a large amount of thermal energy is often still lost if the latent heat of evaporation from the evaporated water cannot be recovered and/or in some way be utilized as direct heat input into the dryer. Tecogen Inc. is conducting research and development on an industrial drying concept. The concept utilizes a superheated steam drying atmosphere with exhaust steam recompression to recover the latent heat in the exhaust that would otherwise be lost. This approach has the potential to 55% of the energy required by a conventional air dryer. Work on Phase I: Feasibility Investigation, has been completed and the results of this work are given in this Phase I Final Report. Two designs are described for steam drying systems, one directly heated and one indirectly heated. The work on Phase I of the program also concentrated on identifying the most significant industrial applications for this superheated steam drying concept. The work consisted of evaluating information gathered from a literature search, a survey of industrial dryer manufacturers product brochures, and material provided by a major industrial dryer manufacturer. Results from the six tasks in Phase I are given. The tasks were: industrial applicability study; exploration of system configurations; designing system elements; laboratory testing; energy savings analysis; and program management and reporting. Reports on the first 5 tasks have been processed separately for inclusion on the data base.

14842 (DOE/ID/12882–1) **Development of the Arc Shattering concept of energy efficient comminution of hard materials: Final report.** Bayless, J.R.; Smith, C.R. Pulse Sciences, Inc., Agoura Hills, CA (USA). Feb 1991. 77p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC07-89ID12882. (PSI-FR–1526). Order Number DE91009883. Source: OSTI; NTIS; GPO Dep.

This research project was performed by Pulse Sciences, Inc. for the US Department of Energy, Idaho Operations Office. The objective of this project was to develop the Arc Shattering concept for efficient electrohydraulic reduction of high volume ores to fine size. The work included: (1) the construction of an experimental Arc Shattering apparatus; (2) experimentation to determine the energy efficiency of comminution under laboratory batch operating conditions; (3) evaluation of the key variables affecting the particle size reduction; (4) development of a conceptual design for a full-scale comminution system and (5) a technoeconomic assessment of Arc Shattering for reduction of high volume ores (tactonite and chalcopyrite) to fine size (approximately 50 microns) for beneficiation. The overall research goal was to demonstrate the feasibility of the Arc Shattering approach to achieve an efficiency of 20% in the generation of increased surface area under batch and continuous operation. The results of the research effort have led to the following conclusions: (1) although some of the experimental data appear promising, there is insufficient information to indicate that the Arc Shattering concept is superior in efficiency to conventional comminution techniques; (2) if further experiments successfully demonstrate high comminution efficiencies, it should be possible to build large scale comminution facilities at a competitive cost and (3) the energy efficiencies achieved with Arc Shattering for reduction from 2.5 cm diameter particles to 50 micron diameter must be <13 kWh/ton for iron ore and <10 kWh/ton for copper ore in order for it to offer advantages relative to conventional comminution processes. 20 figs., 4 tabs.

14843 (DOE/NASA/50162–5) **Mechanical strength and thermophysical properties of PM212: A high temperature self-lubricating powder metallurgy composite.** Edwards, P.M. (Case Western Reserve Univ., Cleveland, OH (USA)); Sliney, H.E.; DellaCorte, C.; Whittenberger, J.D.; Martineau, R.R. Case Western Reserve Univ., Cleveland, OH (USA); National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Dec 1990. 27p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AI01-86CE50162. (NASA-TM–103694). Order Number DE91009678. Source: OSTI; NTIS; GPO Dep.

A powder metallurgy composite, (PM212), composed of metal-bonded chromium carbide and solid lubricants is known to be self-lubricating to a maximum application temperature of 900°C. In this paper, the high temperature compressive strength, tensile strength, thermal expansion and thermal conductivity data needed to design PM212 sliding contact bearings and seals are reported for sintered and isostatically pressed (HIPed) versions of PM212. Other properties presented are room temperature density, hardness, and elastic modulus. In general, both versions appear to have adequate strength to be considered as sliding contact bearing materials, but the HIPed version, which is fully dense, is much stronger than the sintered version which contains about 20 percent pore volume. The sintered material is less costly to make, but the HIPed version is better where high compressive strength is important. 13 refs., 15 figs., 8 tabs.

14844 (DTH-LET-RE–89-4) **Optimization of energy and technological processing systems.** Maagoee Petersen, P. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Energiteknik. 1989. 251p. (In Danish). Order Number DE91763407. Source: OSTI; NTIS (US Sales Only).

The optimization of design and operational strategies for energy systems operating under varying loads and operating conditions, are dealt with. Methods for analyzing overall design and methods for detailed analysis of a plant design are described. The objective is optimization of overall design, but as an example of detailed analysis, the design of a desalination plant is optimized for different operating conditions and with different objectives. Techniques for improving the operation of a plant are illustrated. Relations between design optimization and improving operational strategies are discussed, and it is shown how the lowest possible energy consumption for a plant can be calculated by assuming average loads. It is shown how the target for improved design and operation can be obtained by combining three optimization concepts in two different ways. Design optimization must be combined with simultaneous optimization of the operational strategies for the components in a plant, or alternatively optimal planning and management of the load-variations in a plant, using dynamic programming. The gains obtainable by each, and by combinations of, the three optimization concepts are calculated by simulating real-life load profiles for the refrigerant plant in a brewery and the power plant onboard a reefer vessel. Relations between the methods are illustrated and discussed in the light of mathematical and practical considerations. On the basis of the results of the optimization studies, a number of analytical equations were developed. These permit advance estimation of the gains achievable by applying advanced operational strategies and load management in a plant. (AB) 65 refs.

14845 (ECN-C–90-054) **Ceramic natural gas burners: Report January-December 1989.** Beckers, G.J.J.; Philipse, A.P.; Visser, P.R.; Beesteheerde, J. Netherlands Energy Research Foundation, Petten (Netherlands). Nov 1990. 91p. (In Dutch). Project NOVEM 42.31-004.20/42.320-004.3. Order Number DE91760557. Source: OSTI; NTIS (US Sales Only).

Results of the activities carried out within the framework of the title project are presented. The total 4-year project is aimed at the development and introduction of ceramic natural gas burners. The phases Ia and Ib are discussed. These phases aim at the development of flat burner plates for domestic and industrial applications. The basic material of the plates is alumina-silica. Activities and results in the period January-December 1989 concern system evaluation, burner performance, material preparation, fabrication methods, burner specification, industrial production and industrial application. From the first experiments it appears that ceramic foam can function as a burner plate. However, more knowledge has to be acquired of the material preparation and the processes which occur on and in the plates in order to remove some poor present properties, like inhomogeneity and mechanical strength. 14 figs., 6 refs., 3 apps.

14846 (ENET–8900434/1) **Deep-freeze store with low energy consumption: Closing report.** Reist, B. (Ingenieurbureau B. Reist, Zuerich (CH)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1990. 24p. (In German). Order Number DE91765829. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The energy consumption figures were compiled and analysed for a maximum possible number of deep-freeze chambers of more than 100 m^3 volume. Mesurements were carried out in the Winterthur cold storage. Opportunities were revealed for the identification of improvements measures on the basis of the test results. figs., tabs.

14847 (ENET–8900459/1) **Drawing up scientific principles for energy recovery by means of waste disposal in the plastics industry, using the combustion process by KEVAG AG.** Steiger, U.; Maeder, F. Bundesamt fuer Energiewirtschaft, Bern (Switzerland). 1990. 51p. (In German). Order Number DE91765856. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

During the years 1977 to 1981, KEVAG AG in Wilen-Wollerau developed a batch-working, small-scale combustion plant for synthetic wastes. A semi-technical plant has been in place at the FORBO company since 1981. The concept of the plant contains, in addition to the combustion stage, an energy recovery unit, as well as a flue-gas washer. In the running of the plant, it has been shown that this cannot be used in industrial operations, since it is not sufficiently reliable. Consequently, process-engineering trials had to be carried out in order to investigate the combustion process and enable conclusions to be drawn on the plant concept and design with a view to an improved process operation. figs.

14848 (ETDE/JP-mf–1759127, pp. 49-57) **Demonstration test of low-ash CWM combustion.** Ono, T. (The Coal Mining Research Center, Tokyo (Japan)); Shibata, K.; Shimoyama, T. Coal Mining Research Centre, Tokyo (Japan). Aug 1990. 316p. (In Japanese). In *Commemorative symposium of coal technology for 30th anniversary of the founding of the Coal Mining Research Center, Japan.* Order Number DE91759127. Source: OSTI; NTIS, US Sales Only.

This paper reported the demonstration test of low ash CWM combustion in a practical boiler. A oil fired boiler of 110 t/h was modified so that CWM could be used and flue gas could meet the aimed values sufficiently. Four steam supplying type CWM burners of each capacity of 2.8t/h and a bag filter system for duct collection were equipped. In order to get low ash CWM, Cerrjon raw coal which can easily separate ash and coal at grinding to get coal concentration more than 65% and ash content of 1.5% was used. A deashing equipment of 15t/h was completed in April, 1990 and is operated favorably. After the raw coal was ground to 3mm size or less at the concentration of 40%, ash concentration could be reduced to 2-3% by classifying with a vibrating screen and by removing fine particles. After this was fed to a spiral separator to reduce the ash content to 2%, dewatering was made to get clean coal of 1.5% ash and 15% moisture. Recovered rate was 65%. The modifying job of the combusting equipment is to be finished up to the end of this June and the combustion test is scheduled at the end of July. 3 figs., 4 tabs.

14849 (ETDE-mf–1764468) **Status of and prospects for cadmium substitution.** Boehm, E.; Toetsch, W. Fraunhofer-Institut fuer Systemtechnik und Innovationsforschung (ISI), Karlsruhe (Germany, F.R.); Umweltbundesamt, Berlin (Germany, F.R.). Jan 1989 177p. Contract UFOPLAN 104 08 316. Order Number DE91764468. Source: OSTI; NTIS (US Sales Only).

About 2069 t of cadmium were used in West Germany in 1979. Intensive efforts reduced cadmium consumption to 1079 t in 1981. Since then a weak increase in cadmium consumption can be observed. Other industrialized countries use much less cadmium, at least in certain industry fields. Newly developed PVC-stabilizers based on calzium/zink behave so excellent in laboratory tests, that PVC-processors probably do entirely without cadmium on a medium term. Individual solutions have to be found for the substitution of cadmium pigments. Cadmium pigments can not be substituted in red ceramic glazes, red and yellow signal lights, and a few very demanding plastic applications. Cadmium for corrosion protection can be substituted by zink or better zink/nickel alloys. If additional functions are asked from the coating materials, individual solutions have to be found. The use of nickel/cadmium accumulators increases world wide. As substitution of these batteries is only possible in marginal areas, an efficient recycling system has to be established. (orig.) With 89 refs., 61 tabs., 19 figs.

14850 (ETSU-B–1180) **Evaluation of the GARB refuse processing simulation program and its future potential - final report.** Wheeler, P. (Warren Spring Lab., Stevenage (UK)); Barton, J.R. AEA Environment and Energy, Harwell (UK). Energy Technology Div. 1990. 73p. (WSL-CR–3211(MR)). Order Number DE91763837. Source: OSTI; NTIS (US Sales Only).

An evaluation of the GARB refuse processing simulation developed by the Argonne National Laboratory is presented. In the context of USA/UK liaison activities in this field, the programme of work was carried out by the UK Department of Energy: Energy Technology Support Unit. It was to cover the assessment of the model overall, the status of individual unit operations, calibration modification of models where possible and full evaluation of a UK processing plant. Further development requirements to meet anticipated uses for the model by the waste processing industry were also to be addressed. The fundamental conclusion drawn is that the GARB system and its associated models do not simulate closely enough the unit operations used in refuse processing when applied to UK refuse and conditions. Areas of improvement have been identified. (U.K.).

14851 (EUR–11977) **Opportunities for energy saving through the development of large industrial heat pumps.** Commission of the European Communities, Luxembourg (Luxembourg). 1989. 95p. Contract no. 86-B-7040-11-001-17. Source: OSTI; NTIS (US Sales Only).

This study of the opportunities for energy saving in the European Economic Community through the use of large industrial heat pumps was undertaken to provide the Directorate-General for Energy with a recommended strategy for the development and support of the technology. In undertaking this part of the project for the Commission we have constructed a comprehensive and detailed computerised database on existing industrial heat pumps in the Community. Our database contains entries for over 600 installations within industry in member countries, with information collected from a wide variety of sources. Our database has also been used to provide information and estimates. A detailed list of the installations in each member country is contained. The activities of manufacturers of industrial heat pump systems, as well as the suppliers of key components such as compressors and evaporators, are reviewed. Heat pump manufacturers are the most important single link in the overall development and demonstration effort required to establish the technology within the Community. We have identified and listed the key industrial heat pump companies operating in the EEC, together with the product range manufactured. A summary of our findings on the problems encountered by first generation heat pumps is contained. Our overall assessment of the experience and prospects for large industrial heat pumps in the Community, which forms the basis of our conclusions and recommendations, are discussed and analysed. Although we have devoted some effort to establishing the experience and current position on industrial heat pumps in each of the member countries, the quantitative estimates rely heavily on the position in France and Germany, where extensive experience has been built up and the practical problems and opportunities associated with industrial heat pump technology have been highlighted.

14852 (EUR–12107) **Waste heat utilization for the evaporation of brine.** Commission of the European Communities, Luxembourg (Luxembourg). 1989. 17p. Contract no. EE/082/82-NL. Source: OSTI; NTIS (US Sales Only).

This project reports on the design, construction and operation of a special type of evaporator situated between the last effect and the barometric condenser of a multiple-effect evaporation plant for the production of sodium chloride. In this evaporator about 40% of the heat that is normally transferred at a low temperature level to the cooling water in the barometric condenser, can be used instead to concentrate the feed brine of the salt plant. This will save a substantial part of the energy needed for the evaporation of brine. The aim of the demonstration was to operate the evaporator for a long period on an industrial scale, coupled to an existing brine evaporation plant. The calculated steam savings should be realized at reduced pressure. It was also intended to show that this apparatus can be applied as a crystallizing evaporator, thus rendering it possible to construct evaporators that are generally less energy consuming.

14853 (EUR–12157) **The use of a mechanical vapour recompression (energy-saving) evaporator to concentrate acid casein whey. Demonstration project.** Kearney, O. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 45p. Contract no. EE/410/84-IRL. Source: OSTI; NTIS (US Sales Only).

The aim of the energy demonstration project executed at Kantoher Co-operative Creamery is to use a mechanial vapour recompression evaporator instead of a conventional thermal evaporator, to concentrate hydrochloric acid whey from 6 to 32% total solids content. By this concentration, whey, which is a by-product of casein manufacture, is converted into a commercially viable product for animal feeding. Some minor technical problems occurred during start-up and commissioning of the project which however were soon rectified. On the basis of 5000 hours per year operation, the energy saving compared to a conventional four-stage evaporator amounts to approximately 600 toe, while the payback time based on overcosts is about two years.

14854 (EUR–12171) **Utilization of wind energy in conjunction with a heat pump for greenhouse heating.** O'Flaherty, T. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 56p. Contract no. WE/62/83. Source: OSTI; NTIS (US Sales Only).

The aim of the project was to use an 18.5 kW wind turbine, in conjunction with a heat pump incorporating a novel type of evaporator, in order to supply heat to a 600 m^2 greenhouse.

14855 (EUR–12301) **Concentration of fish stickwater by mechanical vapour recompression. Demonstration project.** O'Neill, G. (Irish Agricultural Wholesale Society Ltd (IE)). Commission of the European Communities, Luxembourg (Luxembourg). 1989. 23p. Contract no. EE/528/85-IR. Source: OSTI; NTIS (US Sales Only).

The main aim of the project is to use mechanical vapour recompression for the concentration of fish stickwater, thereby rendering the process economic and using a by-product, a large volume of which is being dumped. This novel technological approach will make maximum use of the by-product of fishmeal/fish oil manufacture and will lead to improvements in the environment and increased yields from the fishmeal/fish oil plant. The MVR technology using turbo fans is a new application with fish waste in the EEC. The use of the turbo fans demands less electrical power and is easier to maintain. This application will benefit the competitiveness of the fish processing industry of the Community.

14856 (IVO-B–07/90) **Separation technology, energy use and scope of application.** Halonen, A. Imatran Voima Oy (IVO), Helsinki (Finland). 1990. 53p. (In Finnish). Order Number DE91763455. Source: OSTI; NTIS (US Sales Only).

Separation processes are an essential part of almost all fields of the process industries. Different challenges on separation methods apply both conventional and new process industries. The energy use at conventional separation methods is improved in order to decrease expenses, and new methods are developed to meet the requirements stricter than before concerning the purity and the harmful emissions. At the manufacture of special products in the fiedld of, say, biotechnology, the new separation methods are in key position. The research of this sector is in phase of strong development. For competitional reasons, the results are usually donfidential, and it is difficult to get information. Large amounts of resources are used for research, especially in the membrane technology. This report has been compiled on the basis of literature survey, interviews, inquiries and assignments. The most comprehensive assignment concerned the membrane technology, and it was addressed to the Finnish Scientific Councellor in Japan. The report goes through the different separation process methods: extraction, distillation, adsorption, ion exchange, molecular sieves, membrane techniques, and centrifuges. The emphasis is on the energy use of the techniques, and e.g. the possibilities are considered, how to develop the separation processes so as to use less energy than at present.

14857 (NEI-FI-129) **Power savings potential of a bleach plant with new technology.** Fagerstroem, P. (Ekono, Helsinki (Finland)). Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1989. 69p. (In Finnish). Project KTM-284/881/86. Order Number DE91763443. Source: OSTI; NTIS (US Sales Only).

The aim of the paper was to clarify power savings potential in pulp bleaching by studying the effect of new technical solutions and the use of new bleaching chemicals on the consumption of power and chemicals and on the waste water load of the pulp mill. The power consumption of the bleach plant and the aerobic biological waste water treatment plant were also considered. The power consumption of the bleaching chemical production also includes the power consumed for producing chemicals in separate production units. Power savings potential was studied mainly in a 1000 t/d pine sulphate pulp mill. An average bleach plant consumes at present about 20% or 150 kWh/t pulp, of the total power necessary for producing bleached undried pulp. A conventional new five-stage 1000 t pulp/d suction filter washer bleach plant consumes about 120 kWh/t power per ton of pulp. A corresponding diffusion washer bleach plant using medium consistency technology uses power about 15 kWh/t pulp less than a conventional filter washer bleach plant. Power consumption in production of chemicals needed for pine pulp bleaching in a conventional five-stage bleaching is 395 kWh/ton of pulp. Considering a pulp mill with a daily capacity of 1000 t the greatest power savings (62 GWh/a), including power for the bleaching process and for the chemical production is reached by a combination consisting of continued cooking, oxygen bleaching and three-stage bleaching with diffuser washers. The corresponding theoretical power savings potential of the entire Finnish sulphate pulp industry compared with the present consumption figures and production of bleached sulphate pulp (4.15 million t/a) total 864 GWh/a, which corresponds to 108 MW effect in power generation.

14858 (STF-11A90014) **Energy conservation in the shrimp processing industry: Final report.** Hamre, H.C. Stiftelsen for Industriell og Teknisk Forskning (SINTEF), Trondheim (Norway). Mar 1990. 64p. (In Norwegian). Order Number DE91763504. Source: OSTI; NTIS (US Sales Only).

Measurements have been made of the energy consumption in thawings, boiling and freezing, as well as production of hot water in several shrimp processing enterprises in the counties of Troms and Finnmark. The measurements show that great amounts of energy are lost in the production process, in particular in steam boiling of shrimps. The energy consumption may be reduced considerably by process improvements, heat recovery and better control of the relevant section processes. Every section process of the production is analyzed with respect to energy consumption and energy conservation potential. In addition, the production process as a whole is analyzed. Proposals for energy conservation measures are given without concrete calculation of the economic profit. 3 refs., 16 figs., 1 tab.

14859 (SVF-383) **Energy recovery by NOHEX heat transfer: Preliminary study.** Werner, R. (AIB Anlaeggningsteknik AB, Solna (SE)); Hellman, L.G. Stiftelsen foer Vaermeteknisk Forskning, Stockholm (Sweden). Nov 1990. 75p. (In Swedish). Order Number DE91763534. Source: OSTI; NTIS (US Sales Only).

This report presents a technique for heat exchanging, where the heat transport between two different medias is not performed by means of conventional heat exchangers but by introducing a working substance possible to be evaporated respectively condensed in direct contact with either medium. The possibility exists to a lower cost to improve the heat transfer and decrease the mean temperature difference by enlarging the boundary layer between two immiscible liquids under controlled conditions. The lack of heat exchanger surface makes fouling, etc. impossible. Suitable working substances, inert, insoluble in water, etc. are alifatic lower hydrocarbons as e.g. propane, iso-butane, n-butane. The idea of making use of these compounds, already well established in other fields, in heat pumps, Rankine cycles, etc. as alternatives to freons are illustrated with regard to the inner and outer environment. The replacement of freons with hydrocarbons offers true advantages in that respect. By making use of the direct heat transfer without costly heat surfaces the possibility will improve to design and construct and economical Rankine cycle operating with waste heat, the heat pump application not excluded. (authors).

14860 (VAKOLA-TUTK-57) **Dimensioning and use of near-ambient drier.** Sariola, J.; Tuunanen, L.; Paavola, J.; Ahokas, J. Valtion Maatalouskoneiden Tutkimuslaitos, Olkkala (Finland). 1990. 87p. (In Finnish). Project KTM-126/881/85. Order Number DE91763444. Source: OSTI; NTIS (US Sales Only).

Factors affecting near-ambient drying of grain were examined and the results were used to determine drier size and drying strategies including use of supplemental heat and possibilities of combined use of near-ambient drier and heated-air drier. A test of devices for automatic control of drier fans was also part of the study. At 550 m^3/hm^2 and 700 m^3/hm^2 airflow and 0.5 m bed depth static pressure averaged 310 Pa and 483 Pa respectively. As bed depth was increased from 0.5 m 10 1.5 m, the static pressure increased by 620 Pa/m and 923 Pa/m respectively. The relationship between airflow ratio and static pressure was found to agree with the equation $p = aV^2 + bV + c$ when airflow was between 450 and 700 m^3/hm^2. p = static pressure (Pa), V = airflow per hour and floor area (m^3/hm^2) and a,b,c constants which depend on bed depth and kind of cereal. When 5 deg C supplemental heat was applied, drying time was reduced by half and 14-15% target m.c. was easily reached. When the air was heated more than 10 deg C, the difference in m.c. between the bottom and top layer of the grain became too wide. When the airflow was increased from 325 m^3/hm^2 to 750 m^3/hm^2, evaporation rate was doubled and the drying zone reached the top layer in just fourth of the time required with 325 m^3/hm^2 airflow. Airflow rate seemed to have a greater effect on the advance of the drying zone up through the bed than temperature and relative humidity. The fans should be dimensioned to produce at least 550 m^3/hm^2 airflow. Too large fans are better than too small ones because high airflow rate is advantageous for the drying process. If the initial m.c. is over 30%, the maximum bed depth is 40 cm.

14861 (VTT-TUTK-710) **Process flowsheeting.** Kaijalucto, S. (Valtion Teknillinen Tutkimuskeskus, Jyvaeskylae (Finland). Polttoaine- ja Polttotekniikan Lab.); Johnsson, P.; Perttula, M.; Sundquist, A. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Oct 1990. 83p. (In Finnish). Order Number DE91763458. Source: OSTI; NTIS (US Sales Only).

Flowsheeting, the calculation of material and energy balances, forms the basis for the design and analysis of chemical processes. Balance calculations are tedious, often iterative and have been prime targets for computerization. The present report will discuss the applicability of three different flowsheeting programs on practical design problems originating from four different laboratories in the Technical Research Centre of Finland (VTT). The potential applicaiton areas of flowsheeting in biotechnology are summarized in the form of a literature survey. Two of the programs, SSPS, originally developed at Aabo Akademi, and the SIMU-package from Belsim SA, represent the traditional sequential modular approach in flowsheeting. The QUASILIN program from the University of Cambridge applies the more modern equation based approach. SSPS was used to simulate the Carver-Greenfield drying process. The process concept is based on multiple evaporation. The material dried was milled peat. The process simulated by the SIMU-package was an acetic acid process based on partial oxidation of ethene. The same process was also simulated using QUASILIN in order to compare the relative merits of the two approaches. In addition to that QUASILIN was also used to simulate a LiBr - H_2O absorption heat pump and a natural gas fuelled gas turbine process.

14862 **Method and apparatus for burning combustible solid residue from chemical plant.** Nakase, Noriaki; Koyama, Masao; Inada, Masahiro; Masaoka, Toshiaki; Abiko, Tohoru; Takahashi, Kenji. 29 Nov 1990. Filed date 28 May 1990. Canada Patent patent application 2017626. 17p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A method and apparatus are provided for burning a combustible solid residue discharged from a chemical plant, in particular a terephthalic acid plant, and simultaneously providing process heat for the plant. The residues of terephthalic acid plants are solid at

room temperature and contain terephthalic acid, isophthalic acid, benzoic acid, p-toluic acid, by-product high-boiling compounds, and waste catalyst. These residues have hitherto been burned in an independent incinerator, using a heavy oil or gas fuel, which consequently requires an uneconomical extra input of energy in the plant. The method of the invention comprises feeding a slurry of the residues in an oil, the amount of the oil being at least 0.5 wt % of the residues, into a burner in a combustion furnace. The furnace consists of a main combustion chamber having the burner in its arch, a secondary combustion chamber formed in the lower portion of the main combustion chamber, and a flue gas duct provided beneath and following the secondary combustion chamber. Flow of the combustion gas can be assured by providing an induced-draft fan at the tip of the flue gas duct. The residue is burned in the main combustion chamber, and the combustion gas is conducted into the secondary combustion chamber and allowed to reside there at 800-1000°C for at least 0.5 s. A tertiary combustion chamber may be interposed between the flue duct and the induced-draft fan to burn residues which may remain unburned in the combustion gas. A heating pipe, which may be connected to a heating pipe in the main combustion chamber, is provided in the tertiary chamber for heating a medium which can be used to provide process heat for the plant. 5 figs.

14863 **Method and apparatus for introducing combustion air into a furnace.** Simonen, L. 10 Oct 1990. Filed date 6 Apr 1990. Canada Patent patent application 2014037. 20p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A method and apparatus are provided for introducing combustion air into a furnace, notably a furnace of a soda recovery boiler for burning black liquor. Such boilers have typically experienced problems with uneven or inefficient air supply, including loss in combustion efficiency and excessive undesirable emissions. The object of this invention is to increase the capacity and energy efficiency of the boiler by improving the supply of combustion air. More specific objects include production of an air supply in the furnace which is more uniform than that in known techniques, enabling a constant penetration of combustion air into the boiler at different loading levels, and achievement of a better mixing of black liquor and combustion air. According to the invention, combustion air is introduced into the furnace from at least two opposing walls in air jets of at least two sizes, and in such a way that the penetration of the air jets introduced from different air ports increases from the corners of the furnace walls towards the center of the walls. In a soda recovery boiler, the air is advantageously supplied through jets in all four walls whose hydraulic diameter increases from the corners toward the center of the walls. The penetration of air from different ports is maintained substantially constant so that the air jets cover the entire cross-sectional area of the furnace as uniformly as possible at different loading conditions without forming any interlacing of air flows or leaving any significant open areas between the air jets. 5 figs.

14864 **Method for re-using waste sulphuric acid.** Mauer, J.; Bansal, P. 7 Oct 1990. Filed date 6 Apr 1990. Canada Patent patent application 2014001. 17p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A method is provided for reusing the low-concentration waste sulfuric acid resulting from the production of titanium dioxide according to the sulfate method. The waste typically contains about 23% sulfuric acid and metal salts. According to the invention, the waste is concentrated to a sulfuric acid content of about 70 wt % and completely, or at least for the most part, roasted with the precipitated metal salts. The metal oxides resulting from the roasting are conveyed for disposal. The sulfur oxide gases produced in the roasting are converted, with the addition of water, to highly concentrated (on the order of 98%) sulfuric acid, which is returned to the raw titanium material digestion process. Since the proportion of recycled metal compounds is greatly reduced during recirculation, a titanium dioxide pigment of a better quality can be produced with little expenditure in terms of equipment and energy. 3 figs.

14865 **Method and apparatus for heating a gaseous fluid by successive heat exchanges.** Knipiler, G.; Suhas, P.; Gosselin, D. 24 Sep 1990. Filed date 21 Mar 1990. Canada Patent patent application 2012714. 17p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

The production of hot air at high temperature (350-450°C) for industrial processes which require the air to be uncontaminated may be performed by indirect electrical heating or by heat exchange. With the object of overcoming economic disadvantages of the former and the inefficiencies and technical problems of the latter, this invention proposes a new system of heating that permits an increase in the efficiency of the heat exchange apparatus, notably by reducing the differences in temperature between the heated and heating products at each heat exchange step. According to the invention, a flow of fluid to be heated is subjected to a first heat exchange with combustion products in a heat exchanger. This same fluid flow is then subjected to a second heat exchange with a heat exchange fluid circulating in a second heat exchanger. The flow of fluid to be heated is then circulated in a third heat exchanger, in heat exchange with the combustion products before the latter are used during the first heat exchange. This third heat exchanger can comprise radiant tubes and convection surfaces allowing the fluid flow in circulation to be heated essentially by convection. The invention is applicable to air heating, notably in the pharmaceutical industry. 2 figs.

3206 Municipalities and Community Systems

Refer also to citation(s) 14377, 14526, 14541, 14695, 14716, 14739, 14850, 15789

14866 (DOE/CE/26579–T1) **Engineering study to determine most practical application for district chilled water in St. Louis, Missouri: Final report.** Saint Louis Thermal Energy Corp., MO (USA). [1991]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG01-88CE26579. Order Number DE91009993. Source: OSTI; NTIS; GPO Dep.

The City of St. Louis, Missouri is in the final stages of contracting for the construction of a 600 ton per day waste-to-energy facility. This facility will help solve the growing waste disposal problems in St. Louis as well as provide steam energy from a renewable energy source, municipal solid waste. Crucial to the plan to build a waste-to-energy plant in Downtown St. Louis is the development of a district chilled water system. The chilled water system would utilize the steam recovered during the summer months from the incineration process when there was very little load on the district steam system. Phase 1 consisted of engineering work required to determine the equipment, system, layout and costs of a large steam driven chilled water producing plant (6000 to 20,000 tons capacity) installed in the existing Ashley district steam boiler plant. The Phase 1 work also considers the costs and the benefits to the project of the generation of electricity using steam from the waste-to-energy plant which is not needed to satisfy the load of the district steam system or the district chilled water system. Results are discussed.

14867 (EUR–12099) **Vester Nebel combined collective heat supply system. Demonstration project.** Oersted, H.; Majland, O. Commission of the European Communities, Luxembourg (Luxembourg). 1989. 48p. Contract no. SE/739/83-DK. Source: OSTI; NTIS (US Sales Only).

The Vester Nebel project began in 1983. Its objective was to demonstrate the possibilities of installing a collective heat supply based on different types of local renewable energy sources and designed to serve small communities. This report gives a description of the plant and its operation, the results on the measurements and the experience obtained during the operation of the plant. The plant comprised several heat production units: solar collector, heat pump, straw furnace, oil-fired furnace and wind turbines. The solar collector operated independently from the other units. The heat pumps went into operation when the output from the solar collector was insufficient to meet demand. The straw furnace was thereafter in operation. The oil-fired furnace was used as a peak-load unit.

The results of the operation during the last twelve months were used as a basis for evaluating the economic viability of the project.

14868 (LBL–29748) **Building code compliance and enforcement: The experience of San Francisco's residential energy conservation ordinance and California's building standards for new construction.** Vine, E. Lawrence Berkeley Lab., CA (USA). Nov 1990. 40p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010229. Source: OSTI; NTIS; GPO Dep.

As part of Lawrence Berkeley Laboratory's (LBL) technical assistance to the Sustainable City Project, compliance and enforcement activities related to local and state building codes for existing and new construction were evaluated in two case studies. The analysis of the City of San Francisco's Residential Energy Conservation Ordinance (RECO) showed that a limited, prescriptive energy conservation ordinance for existing residential construction can be enforced relatively easily with little administrative costs, and that compliance with such ordinances can be quite high. Compliance with the code was facilitated by extensive publicity, an informed public concerned with the cost of energy and knowledgeable about energy efficiency, the threat of punishment (Order of Abatement), the use of private inspectors, and training workshops for City and private inspectors. The analysis of California's Title 24 Standards for new residential and commercial construction showed that enforcement of this type of code for many climate zones is more complex and requires extensive administrative support for education and training of inspectors, architects, engineers, and builders. Under this code, prescriptive and performance approaches for compliance are permitted, resulting in the demand for alternative methods of enforcement: technical assistance, plan review, field inspection, and computer analysis. In contrast to existing to construction, building design and new materials and construction practices are of critical importance in new construction, creating a need for extensive technical assistance and extensive interaction between enforcement personnel and the building community. Compliance problems associated with building design and installation did occur in both residential and nonresidential buildings. 12 refs., 5 tabs.

14869 (NYSERDA–88-17) **District heating feasibility, Industrial Corridor, Jamestown, New York: Final report.** Burns and Roe, Inc., Oradell, NJ (USA). Jun 1988. 272p. Sponsored by New York State Energy Research and Development Authority, Albany, NY (USA). Source: OSTI; New York State Energy Development Authority, Two Rockefeller Plaza, Albany, NY 12223.

The Industrial Corridor of Jamestown, New York, contains more than twenty industrial/manufacturing companies, whose thermal demands, in addition to space heating, include significant process heating loads. This study investigated in depth, the technical and economic feasibility of implementing a district heating system in the Industrial Corridor which can serve both process and space heating loads. Based upon the heat load assessment conducted, the study focused upon nine companies with the largest thermal demand. Alternative system implementation designs were considered including new conventional centralized boiler plants, gas turbine cogeneration, and both high temperature hot water and steam as the heat transport media in an underground distribution system. The study concluded that, in view of the nature of existing prospective customer loads being primarily steam based, the most economical system for near term phased development is a steam based system with a new conventional centrally located steam boiler plant. The economic potential for a cogeneration system was found to be sensitive to electricity buy back rates, which at present, are not attractive. Implementing a modern high temperature hot water system would require significant customer retrofit costs to convert their steam based systems to hot water, resulting in long and unattractive pay back periods. Unless customer hot water retrofit costs can be expended without penalty to the district system economics, hot water district heating is not considered economically feasible. Chapters describe heat load assessment; heat source analysis; system implementation; transmission and distribution systems assessment; institutional assessment; system economic analysis; and customer retrofit, economic analysis, and conclusions 20 figs., 22 tabs.

14870 (NYSERDA–88-18) **District heating and cooling feasibility study, Dunkirk, New York: Phase 1: Final report.** New York State Energy Research and Development Authority, Albany, NY (USA); Burns and Roe, Inc., Oradell, NJ (USA). Jun 1988. 113p. Sponsored by New York State Energy Research and Development Authority, Albany, NY (USA). Source: OSTI; New York State Energy Development Authority, Two Rockefeller Plaza, Albany, NY 12223.

The objective of this project is to perform a preliminary investigation of the technical and economic feasibility of implementing a district heating and cooling (DHC) system in the City of Dunkirk, New York. The study was conducted by first defining a heating and cooling (HC) load service area. Then, questionnaires were sent to prospective DHC customers. After reviewing the owners responses, large consumers of energy were interviewed for more detail of their HC systems, including site visits, to determine possibilities of retrofitting their systems to district heating and cooling. Peak HC loads for the buildings were estimated by Burns and Roe's in-house computer programs. Based on the peak loads, certain customers were determined for suitability as anchor customers. Various options using cogeneration were investigated for possible HC sources. Equipment for HC sources and HC loads were sized and their associated costs estimated. Finally, economic analyses were performed. The conclusion is that it is technically and economically feasible to implement a district heating and cooling system in the City of Dunkirk. 14 figs., 15 tabs.

3209 Education and Public Relations

Refer also to citation(s) 14783

33 ADVANCED PROPULSION SYSTEMS

Refer also to citation(s) 15974

14871 (NAL-TR–1066) **Experiment on supersonic turbulent mixing layers.: Supersonic-subsonic two-stream layers.** Murakami, A. (National Aerospace Laboratory, Tokyo (Japan)); Komuro, T.; Kudo, K.; Masuya, G.; Chinzei, N. National Aerospace Lab., Chofu, Tokyo (Japan). May 1990. 16p. (In Japanese). Order Number DE91764225. Source: OSTI; NTIS (US Sales Only).

The mixture of air and fuel, taken in, largely contributes to the combustor, in performance, of ram jet or air suction rocket. The present research, following the previously reported one, investigated the supersonic-subsonic two-stream mixing layer in properties, through experiment thereon. Under the condition that the supersonic side of two-stream layer unit be 2.3 in Mach number, while its subsonic side be, by an adjusting orifice, 0.19 to 0.80 in Mach number, experiment was made to give the following result: The self-similar velocity appropriately agrees in distribution with the single-stream incompressible mixing layer. With lowering in velocity ratio, the center of mixing layer moves toward the low-velocity side. In the single-stream mixing layer, x-axial change in its center diminishes with increasing in Mach number of free-stream. As compared with the velocity, the density slips off in distribution toward the high-velocity side. The spreading rate of supersonic mixing layer can be expressed by a correlation formula, taking the effect of compressibility and velocity ratio into consideration. The shearing stress is almost similar in distribution and its maximum value decreases with increasing in compressibility. 46 refs., 19 figs., 2 tabs.

14872 (NAL-TR–1067) **Autoignition and flameholding in a cylindrical scramjet combustor.** Kudo, K. (National Aerospace Laboratory, Tokyo (Japan)); Masuya, G.; Komuro, T.; Murakami, A.; Chinzei, N. National Aerospace Lab., Chofu, Tokyo (Japan). May 1990. 10p. (In Japanese). Order Number DE91764226. Source: OSTI; NTIS (US Sales Only).

Reliable ignition and flameholding in a supersonic air flow of a scramjet combustor is a matter of the highest priority for its practical utilization. The following results could be obtained by performing experiments as to autoignition and flameholding in a cylindrical scramjet combustor with a reward-facing step. Autoignition occurred when the air total temperature was above 1500K. There were three categories of autoignition; ignition occurred in the

separation region at the combustor exit produced by a shock wave; ignition occurred in the regions of shock wave impinging on the combustor wall; and ignition occurred in the vicinity of the injection holes or the step. The temperature limit when autoignition occurrs in the separation region of shock wave at the combustor exit produced by a shock wave becomes higher with the increase of air total pressure, but this limit is not affected by the air total pressure when ignition occurrs in the regions of shock wave impinging on the combustor wall. For air total temperature above 2500K, ignition and fameholding occur near the step and for temperature between 1600K and 2500K, it moves downward of the step. 8 refs., 12 figs.

3301 Internal Combustion Engines

Refer also to citation(s) 14702

14873 (CONF-910601–2) **NDE [nondestructive examination] development for ceramics for advanced heat engines.** McClung, R.W. (McClung (R.W.), Powell, TN (USA)); Johnson, D.R. Oak Ridge National Lab., TN (USA). [1991]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 36. international gas turbine and aeroengine congress and exposition: ASME turbo expo; Orlando, FL (USA); 3-6 Jun 1991. Order Number DE91005516. Source: OSTI; NTIS; GPO Dep.

The Department of Energy (DOE) Ceramic Technology for Advanced Heat Engines (CTAHE) project was initiated in 1983 to meet the ceramic technology needs of DOE's advanced heat engines programs (i.e., advanced gas turbines and low heat rejection diesels). The objective is to establish an industrial ceramic technology base for reliable and cost-effective high-temperature components. Reliability of ceramics was recognized as the major technology need. To increase the material reliability of current and new ceramics, advances were needed in component design methodology, materials processing technology, and data base/life prediction. Nondestructive examination (NDE) was identified as one of the key elements in the approach to high-reliability components. An assessment was made of the current status of NDE for structural ceramics, and a report was prepared containing the results and recommendations for needed development. Based on these recommendations, a long-range NDE development program has been established in the CTAHE project to address these needs.

14874 (CONF-910617–1) **Low heat rejection diesel ceramic coupon tests.** Brinkman, C.R.; Liu, K.C.; Graves, R.L.; West, B.H. Oak Ridge National Lab., TN (USA). [1991]. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 4. international symposium on ceramic materials and components for engines; Goeteborg (Sweden); 10-12 Jun 1991. Order Number DE91006274. Source: OSTI; NTIS; GPO Dep.

Results are reported from studies in which several monolithic ceramic materials in the form of modulus-of-rupture bars were exposed for 100 h to the combustion conditions found in either a small single- or two-cylinder diesel engine. Fuels included a standard Phillips D-2 diesel or synthetic mixture of the Phillips D-2 and an aromatic blend. The ceramics included two commercial grades of partially stabilized zirconia (PSZ-TS and PSZ-MS), silicon nitride (GTE WESGO SNW-1000 and Norton NT-154), and (Hexoloy SA) silicon carbide. Significant reductions in postexposure four-point bend fracture strength occurred in the PSZ-TS material irrespective of whether it was exposed in the single- or two-cylinder engine. Only a small decrease in fracture strength occurred in the PSZ-MS material, and essentially no decrease in fracture strength occurred in the silicon nitride (GTE WESGO SNW-1000) when tested at room temperature. The Norton NT-154 silicon nitride was tested at both room temperature and at 700°C over several strain rates ranging from 1×10^{-4} to $1 \times 10^{-7} s^{-1}$. Room temperature tests indicated that the engine exposed bars actually showed a slight increase in average strength, 830 MPa, versus 771 MPa for the unexposed material. Elevated temperature strength comparisons showed no reduction in strength due to previous engine exposure. Hexoloy SA silicon carbide showed no reduction in fracture strength when tested at 700°C. 4 refs., 12 figs., 1 tab.

14875 (CRIE-T–89059) **Water-cooling technique of high temperature gas turbine blade.: Thermal efficiency of water-cooled gas turbine.** Sakuma, T. (Central Research Institute of Electric Power Industry, Tokyo (Japan)). Central Research Inst. of Electric Power Industry, Komae, Tokyo (Japan). Energy and Environment Lab. May 1990. 26p. (In Japanese). Order Number DE91764238. Source: OSTI; NTIS (US Sales Only).

A simulation code has been developed that can evaluate the temperature of stationary blades and moving blades and thermal efficiency of gas turbine cycle for different conditions such as inlet temperature, on the gas turbine cycle when the water cooled blades installed concentric tube type open thermosyphon was adopted for moving blades and the forced convection water cooling was adopted for stationary blades on the basis of the proposition of the Central Research Institute of Electric Power Industry. The code proved that for a gas turbine with the inlet gas temperature of 1,500 centigrade it was possible to keep the moving blade temperature under 600 centigrade and the thermal stress under 20kg/mm ^{2}. Therefore, selecting ranges of blade materials are widened and ways to simplify cooling structures are opened, contributing to the reduction of manufacturing costs. It was also clarified that the thermal efficiency when water cooling was used for moving and stationary blades was higher than that obtained by air cooling or steam cooling being under development. 6 refs., 24 figs.

14876 (EUR–12859) **Development and evaluation of a three-dimensional fuel spray model for reciprocating engines: Final report.** Schindler, K.P. (Volkswagenwerk AG, Wolfsburg (Germany, F.R.)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Volkswagenwerk AG, Wolfsburg (Germany, F.R.). 1990. 26p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract No. EN3E-0102-D. Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

Fuel spray behavior in internal combustion engines is almost unknown, although great effort has been devoted world wide at primary research centers and industries. In particular Diesel sprays have been the subject of intensive study over many years. The understanding and prediction of Diesel sprays requires knowledge of penetration, vaporization and mixing characteristics. Access to this information has been impeded by the complexities of Diesel sprays. The overall objective of the European collaborative research program (1) to develop a documented and validated code for computation of fuel sprays (typically Diesel oil and gasoline) in reciprocating engines, which can be incorporated into a global 3D engine combustion code and (2) to investigate the spray behavior in real or simulated engine conditions (high pressure and high temperature) and to prepare a data base for model development and validation. The use of an engine model will support the design of more efficient engines and thus conserve energy resources and reduce harmful effects on the environment and will enable companies to reduce time and cost to develop new engines. 13 refs., 9 figs.

14877 (NAL-TM–620) **Research on aerodynamic control of blade tip clearance flow in air-cooled turbine.** Usui, H. (National Aerospace Laboratory, Tokyo (Japan)); Inoue, S.; Minoda, M.; Nose, H. National Aerospace Lab., Chofu, Tokyo (Japan). May 1990. 20p. (In Japanese). Order Number DE91764223. Source: OSTI; NTIS (US Sales Only).

Nowadays, cooling measures being taken against the heightening in inlet temperature, for the purpose of heightening the gas turbine in efficiency, it is necessary to also take into consideration the influence of cooling air outlet, to cool the turbine blade, on the main flow. In the present research, using a newly designed/prepared rotating unit to test the air-cooled turbine in aerodynamics, influence on the performance was investigated in case of cooling air outlet from the shroud ring at the moving blade tip. Also, influence was investigated of outlet angle, moving blade tip clearance, etc. As a result, elucidation was made as follows: With enlargement in blade tip clearance, the flow rate at the turbine entrance almost uniformly heightens at an arbitrary expansion ratio. The thermal isolation efficiency, as defined only by use of main flow, uniformly heightens at an arbitrary expansion ratio, in case

that cooling air exists. The thermal isolation efficiency, where cooling air is also regarded as operating fluid, is equal regardless of whether or not cooling air exists. While the existence of cooling air outlet gave a similar effect to that, given by the diminution in blade tip clearance. 11 refs., 20 figs., 2 tabs.

14878 (NAL-TR–1064T) **Hydrogen fueled subsonic-ram-combustor model tests for an air-turbo-ram engine.** Tamaru, T. (National Aerospace Laboratory, Tokyo (Japan)); Shimodaira, K.; Saito, T.; Yamada, H.; Horiuchi, S. National Aerospace Lab., Chofu, Tokyo (Japan). Apr 1990. 13p. Order Number DE91764224. Source: OSTI; NTIS (US Sales Only).

In order to examine the characteristics of a hydrogen fueled subsonic-ram-combustor for an air-turbo-ram engine, three types of model flame holders scaled [1/10] of an estimated actual size were tested under severe inlet air conditions similar to those in hypersonic flight. The gutter type model offered the highest performance, and could meet the required combustor operational conditions derived through system analysis up to flight Mach number 3, however, the other two models with swirling blades offered poor performance. The temperature and Mach number of combustion gas were calculted from total pressure at a combustion duct exit and static pressure on a duct wall by unidimensional analysis, and radial profiles of an equivalence ratio and combustion efficiency were obtained by analysis of sampled exit gas. As a result, it was indicated that a fuel rich zone over stoichiometry had to be inhibited from its preparation to attain the best combustion efficiency under conditions near stoichiometric mixture required for engines in hypersonic flight. 5 refs., 16 figs., 2 tabs.

14879 Rotor of a compression-wave engine. Althaus, R.; Keller, J. 9 Oct 1990. Filed date 21 Feb 1990. Canada Patent patent application 2010583. 11p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

Compression-wave engines are used as superchargers for internal combustion engines and as the high-pressure compression stage of a gas turbine. An invention is proposed with the object of improved configuration of the geometry of the rotor of a compression-wave engine operated with media of different density. The configuration of the invention is done in such a way that in the supercharging cycle, no centrifugal forces act on the fluid in the rotor cells. Consequently, centrifugal flows which cause harmful mixing of the fluids of different density are avoided. According to the invention, the rotor has cells on its periphery which are concavely curved on the two end faces of the rotor inwards towards its center and towards the rotor axis. A consequence of this design is that the absolute trajectory of a particle runs from its entry point into a cell up to its exit point from the cell in a virtually rectilinear fashion. In the scavenging process, the mixing zone between the two media participating in the compression wave process, and thus the scavenging losses, are greatly reduced in comparison with straight cells in conventional rotors. 2 figs.

14880 Combustion chamber of a gas turbine. Keller, J. 15 Sep 1990. Filed date 6 Mar 1990. Canada Patent patent application 2011545. 18p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull. Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

An object of this invention is to minimize the NOx emissions in a combustion chamber of a gas turbine. For this purpose, one small premixed (or pilot) burner is provided between every 2 large premixed burners, both types of burners generating a swirl in the same flow rotational direction. The size ratio of the 2 types of burners, in terms of the air flowing through them, is determined on a case by case basis. The pilot burners operate as independent premixed burners over the whole of the load range of the combustion chamber, the ratio of actual to stoichiometric air/fuel ratios remaining almost constant. Because the pilot burners can be operated with an ideal mixture over the whole of the load range, the NOx emissions are very low even at part load. An advantageous embodiment of the invention is achieved if the main and pilot burners consist of different sizes of double-cone burners and if the latter are integrated into an annular combustion chamber. This arrangement enables ignition by the pilot burners only. The fuel supplied to these burners is increased during run-up until the full fuel quantity is available; further increase in output then takes place by the main burners. Very good burnout with low CO/unburnt hydrocarbon emissions is also obtained when the main burners are run very weak in the part-load range, because the hot vortices of the pilot burners penetrate immediately into the cold vortices of the main burners. 7 figs.

14881 Two cycle engine with fuel injector. Suzuki, Kazuo; Tachibana, Fusao; Chonan, Mitsugi. 17 Jul 1990. Filed date 29 Nov 1989. Canada Patent patent application 2004179. 17p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A two-cycle engine with fuel injector is provided, comprising a crankcase, intake ports, throttle bodies, and fuel injectors provided in the throttle valves. The throttle bodies comprise throttle passages respectively connected to the intake ports and a balance passage connecting the throttle passages downstream of the throttle valve. An air chamber may be formed in the balance passage. The downstream sides of the throttle valves located in the respective throttle passages are connected to each other through the balance passage, so that the reversely flowing gas caused in one cylinder flows into another cylinder at the intake timing through the balance passage. Accordingly, the distribution of the mixture on the downstream side of the throttle valve becomes uniform and the reverse flow of the mixture towards the upstream side can be substantially eliminated. The air chamber in the balance passage attenuates the pulsation of the mixture flow, whereby the engine output and the acceleration performance may be improved. In addition, the reverse flow caused in one cylinder is fed to another cylinder by connecting the throttle passages of one group of cylinders having a phase difference of 180° through the balance passage at the air intake timing. The air-fuel ratio can be improved as well as the fuel consumption and exhaust emission efficiencies. 6 figs.

3302 External Combustion Engines

14882 (CONF-870804–51) **A single-cylinder valveless heat engine.** Chen, N.C.J.; West, C.D. Oak Ridge National Lab., TN (USA). [1987]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 22. intersociety energy conversion engineering conference; Philadelphia, PA (USA); 10-14 Aug 1987. Order Number DE91009646. Source: OSTI; NTIS; GPO Dep.

A single-cylinder, single-piston heat engine with no valves is described. Because heat is supplied from an external source, a wide variety of heat sources or fuels could be used. The ideal performance of the thermodynamic cycle is calculated. A reasonable power output and indicated efficiency appear to be attainable from a machine of practicable size, operating under very modest temperature and pressure conditions. 5 refs., 5 figs., 3 tabs.

3303 Electric-Powered Systems

Refer also to citation(s) 14670, 14774, 15070

14883 (ENET–8900079-1) **The status of small electric cars from an energy point of view.** Kriesi, R. (Kantonale Energiefachstelle, Zuerich (CH)). Bundesamt fuer Energiewirtschaft, Bern (Switzerland). Dec 1988. 12p. (In German). Order Number DE91765820. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

The logically thought-out solarmobil has the solar cells on the roof and is, therefore, a small electromobil. In discussions hitherto about the energy consumption of small electromobiles the only talk has been of the drive energy. However, small electromobiles also have to be produced, they need replacement batteries, they drive on roads built by energy-intensive methods, which, in turn, have to be maintained. If we take all these components together, then we obtain a value that is significantly higher than the driving energy alone. The reduced consumption compared with the traditional car, even if we consider the facts in this light, remain impressive. The question of the origin of the electricity providing the driving energy is, however, further relativized, but we are still a long way from the 'innocence' of this new type of individual means of transport that

we are striving for, if the driving current is generated by solar cells. 2 figs., 2 tabs., 3 refs.

3307 Emission Control

14884 Process for purifying exhaust gas and catalyst molded article for use in it. Hanada, Masayuki; Fukuda, Morio; Koshikawa, Takeo; Yamauchi, Akihiro; Ogura, Hiroshi. 28 Sep 1990. Filed date 27 Mar 1990. Canada Patent patent application 2013100. 26p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A catalyst is provided for purification of an exhaust gas that makes non-toxic nitrogen oxides in an exhaust gas in a heavy-oil-firing boiler, a coal-firing boiler, a sintering furnace, a diesel engine, or the like, by a catalytic reduction method. The invention is especially applicable to removing NOx from exhaust gases in diesel engines. According to the invention, the exhaust gases are passed at a temperature of 250-550°C in the presence of a reducing agent through a catalyst bed filled with a molded denitration catalyst comprising at least the 3 following catalyst components: an oxide of at least one metallic element selected from the group comprising Ti, Si, and Zr; an oxide of at least one metallic element selected from the group comprising Mo and W; and an oxide of vanadium. The concentrations of the second oxide and/or the vanadium oxide are selected such that they are higher in the exhaust gas inlet side of the catalyst than in the outlet side. Other oxide components or other metallic components may be added to the catalyst, if required. The catalyst of the invention is preferably made in a honeycomb form when used for purifying exhaust gases of diesel engines. A process for producing the catalyst of the invention is also provided. Experiments are described to illustrate the invention. 1 fig., 1 tab.

14885 Catalyst for purification of exhaust gas from diesel engine. Horiuchi, Makoto; Miyake, Noboru; Kushihara, Toshimasa; Saito, Koichi. 18 Sep 1990. Japan Patent priority 2582189:CA patent application 2009165. 17p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A catalyst for use in purifying the exhaust gases from diesel engines is disclosed. The catalyst is of the flow-through type having parallel cells in a honeycomb structure. The cross-sectional area at the exhaust gas inlet cut by a face vertical to the direction of the cells is 10 to 100 cm^2, preferably 20 to 60 cm^2 per liter of engine displacement. The hydraulic diameter of the cells is 1.00 to 2.00 mm, preferably 1.10 to 1.40 mm. The percentage of open frontal area at the exhaust gas inlet is 40-95%, preferably 50-85%. This catalyst can be one in which a catalytically active component itself is extruded into a honeycomb shape, or one in which a catalytically active component is deposited on a honeycomb carrier. Tests are described to illustrate the performance of catalysts according to the invention. 3 tabs.

14886 Catalytic composite for purifying exhaust gases and a method for preparing the same. Fukuda, Hiroshi; Matsumoto, Ikuo; Tabata, Kenji. 24 Jul 1990. Filed date 13 Dec 1989. Canada Patent patent application 2005411. 34p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A catalytic composite is disclosed which is capable of completely burning unburnt portions of hydrocarbons and CO to decompose into carbon dioxide and water, the hydrocarbons and CO being released from combustion equipment, automobiles, and the like. The catalytic composite of the invention comprises ceramic fibers, oxidation catalysts supported on the surface of the ceramic fibers and in the interstices between these fibers, and inorganic binders for binding the oxidation catalysts to the ceramic fibers. The composite is provided with vent holes for the passage of exhaust gases. In a preferred embodiment, the composite has a honeycomb structure. The oxidation catalysts may comprise perovskite-type compound oxides of the formula AXO_3, where A is selected from the group containing La, Sr, and Ce, and X is selected from the group consisting of Co and Mn. In another embodiment, the oxidation catalysts comprise delafosite-type compound oxides of the formula $CuXO_2$, X having the same meaning as above. The ceramic fibers may be made of alumina and/or silica. A method for preparing the catalyst composite is also provided. Experiments are described to illustrate the invention. 4 figs.

3308 Alternative Fuels

Refer also to citation(s) 14702

14887 (SV-UG–90-63) **Automotive fuels from source to end use - phase one.** Ekelund, M. (Ecotraffic AB (SE)). Swedish State Power Board, Vaellingby (Sweden). 28 Dec 1990. 126p. (In Swedish). Order Number DE91763514. Source: OSTI; NTIS (US Sales Only).

The purpose of this pre-study is to analyse the full upgrading of automotive fuels for use in Sweden. The scope of this pre-study is to perpare for a more comprehensive study. This second phase study will explore energy utilization, emissions and environmental impact, possibly including health aspects, relative to the end use of automotive fuels. The fuels of interest in these studies are diesel oil, gasoline, LPG (propane), methanol from CNG, ethanol from crops, CNG, biogas, vegetable oil, hydrogen and electricity generated from a natural gas fueled combined cycle power plant. The processing and production of fuels consumes a considerable amount of energy. For example, the processing of fossil fuels, accounts for 10% of the total energy input. Ethanol and hydrogen show higher figures in this preliminary study. For ethanol, 80-200%, and for hydrogen some 160%. Within this range are hydro-electric power (20%), purified biogas (40%), methanol (50%), vegetable oil (70%), and natural gas-based electricity (110%). According to preliminary analysis, biogas in the transportation sector, including usage in buses, contributes the least to atmospheric carbon dioxide. Approximately 50 g/tonkm could be associated with biogas usage, whereas diesel oil, gasoline and methanol yield 100 g/tonkm. Again, between these extremes lie ethanol (60 g/tonkm), natural gas based electricity (80 g/tonkm). and CNG (90 g/tonkm). It is important in this context to note that biogas and ethanol originates from renewable resources. Compared separately, the end-use emissions (NO_x, THC, CO, PM) from city buses provide lower figures for electricity and hydrogen, than with the other fuels in this study which yield a mixed range of results with regard to HC, CO, and PM. However, NO_x emissions from methane fueled engines indicate lower levels, down towards 1 g/kWh, whereas the other fuels seem to be limited to a 2-4 g/kWh level. (author) (127 refs.).

35 ARMS CONTROL

3501 Policy, Negotiations, and Legislation

Refer also to citation(s) 15214

14888 (IAEA-INFCIRC–390) **Agreement of 19 December 1990, between the Republic of Kiribati and the International Atomic Energy Agency for the application of safeguards in connection with the Treaty on the Non-Proliferation of Nuclear Weapons.** International Atomic Energy Agency, Vienna (Austria). Mar 1991. 35p. Order Number DE91626178. Source: OSTI; NTIS (US Sales Only); INIS.

The document contains two parts. The first part stipulates the agreement of the Republic of Kiribati to accept safeguards on all source or special fissionable material in all peaceful nuclear activities within its territory, under its jurisdiction or carried out under its control anywhere, for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices. The second part specifies the procedures to be applied in the implementation of the safeguards provisions of Part I.

14889 (UCRL-CR–105634) **Changing Soviet views of nuclear weapons.** Sloss, L. (Sloss (Leon) Associates, Washington, DC (USA)). Lawrence Livermore National Lab., CA (USA); Sloss (Leon) Associates, Washington, DC (USA). Oct 1990. 42p.

Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91010255. Source: OSTI; NTIS; GPO Dep.

The purpose of this paper is to summarize current Soviet views about nuclear weapons, and to assess the implications of these views for US policies and programs. I will focus particularly on implications of interest to the nuclear laboratories. The task is complicated by the fact that Soviet views about nuclear weapons are not straightforward. There are certain benefits from glasnost in that there now is more open debate about a range of issues in the Soviet Union, including defense issues. Thus, we now have a great deal of published material to draw upon in assessing Soviet views, and experts in the West can talk much more freely to Soviet experts. However, this information explosion makes it more difficult to discriminate signal from noise, particularly as there continues to be both propaganda and deception in Soviet statements about defense issues. Clearly, some Soviet statements about nuclear weapons are designed to influence attitudes and actions in the West. I shall cite some examples in this paper.

14890 (UCRL-JC–105885) **Treaty verification with an uncertain partner.** Weissenberger, S. Lawrence Livermore National Lab., CA (USA). Jan 1991. 36p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9106112–1: International conference on game theory, Florence (Italy), 25-27 Jun 1991). Order Number DE91007148. Source: OSTI; NTIS; GPO Dep.

A simple model is used to analyze the performance of a system for verifying compliance with an arms control treaty. Blue and Red are partners in to a treaty. Blue prefers to comply, but is uncertain whether Red similarly prefers compliance (in the absence of threatened violation detection). Blue's uncertainty is modeled as a probability distribution over three different Red types: Violators, Compilers, and Deterrables. Criteria are derived to determine the level at which Blue should set his detection threshold, and when it is best for Blue not to verify at all. The results involve both game-theoretic and Bayes solutions. 9 refs., 14 figs.

3503 Verification

Refer also to citation(s) 14890, 14961, 15993

36 MATERIALS

Refer also to citation(s) 14703

14891 (DOE/ER/45315–15) **Boundary stability under nonequilibrium conditions: Progress report, 31 March 1990–5 February 1991.** Hackney, S.A.; Plichta, M.R.; Lee, J.K. Michigan Technological Univ., Houghton, MI (USA). Dept. of Metallurgical Engineering. [1991]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-87ER45315. Order Number DE91009262. Source: OSTI; NTIS; GPO Dep.

The past two decades have seen a tremendous advance in the basic understanding of interfacial structure at equilibrium. However, the contributions of interfaces to the overall behavior of a material in service (in a power plant or nuclear reactor) occurs under conditions far from equilibrium. This research program is focused on understanding the interaction of nonequilibrium conditions with the equilibrium microstructure of the interface, the net result being increased knowledge of design parameters for materials and materials interfaces to be exposed to the nonequilibrium conditions so prevalent in energy generation systems. To this end, the research program, Boundary Stability Under Nonequilibrium Conditions studies the microscopic behavior of interfaces under the experimentally and theoretically simulated conditions of stress and thermal fatigue, compositional inhomogeneities, and gradients in capillarity forces. 3 figs.

3601 Metals and Alloys

Refer also to citation(s) 14031, 14032, 14033, 14034, 14414, 14415, 14416, 14417, 14616, 14619, 14640, 14699, 14751, 14777, 15012, 15183, 15926, 15932, 15934, 15941, 15952, 16021

14892 (ANL/CP–72530) **Applications of energetic particles in improving coating adhesion properties.** Fenske, G.R. Argonne National Lab., IL (USA). [1990]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-9011183–1: Potential applications of concentrated solar photons workshop, Golden, CO (USA), 7-8 Nov 1990). Order Number DE91008833. Source: OSTI; NTIS; GPO Dep.

This paper addresses one approach (on-beam-assisted deposition, or IBAD) that utilizes energetic ion beams to enhance the adhesion of metallic films to metallic and ceramic substrates. In one application, IBAD is used to improve the adhesion of silver films to ceramic substrates that are subjected to sliding wear conditions at elevated temperatures. In another application, the IBAD process is used to improve the adhesion and modify the microstructure of chromium films deposited on low-Cr steel. Both applications suggest that adhesion can be increased by a number of mechanisms including (a) physical and chemical sputtering of surface contaminants (e.g., hydrocarbons and adsorbed water molecules); (b) preferential sputtering of a particular element of a compound, thus producing a surface enriched in a species that is chemically active with the depositing species; (c) activating chemical states; (d) mechanically roughening the surface, producing more surface area for bonding and sites to arrest surface cracks; and (e) recoil-mixing during the initial stage of film deposition. 17 refs., 1 fig.

14893 (CONF-900610–2) **Application of elastic and elastic-plastic fracture mechanics methods to surface flaws.** McCabe, D.E. (Oak Ridge National Lab., TN (USA)); Ernst, H.A.; Newman, J.C. Jr. Oak Ridge National Lab., TN (USA). [1990]. 53p. Sponsored by USDOE, Washington, DC (USA); National Aeronautics and Space Administration, Washington, DC (USA). DOE Contract AC05-84OR21400. From 22. national symposium on fracture mechanics; Atlanta, GA (USA); 26-28 Jun 1990. Order Number DE91009936. Source: OSTI; NTIS; GPO Dep.

Fuel tanks that are part of the External Tank assembly for the Space Shuttle are made of relatively thin 2219-T87 aluminum plate. These tanks contain about 917 m of fusion weld seam, all of which is nondestructively inspected for flaws and all those found are repaired. The tanks are subsequently proof-tested to a pressure that is sufficiently severe to cause weld metal yielding in a few local regions of the weld seam. The work undertaken in the present project was to develop a capability to predict flaw growth from undetected surface flaws that are assumed to be located in the highly stressed regions. The technical challenge was to develop R-curve prediction capability for surface cracks in specimens that contain the flaws of unusual sizes and shapes deemed to be of interest. The test techniques developed and the elastic-plastic analysis concepts adopted are presented. The flaws of interest were quite small surface cracks that were narrow-deep ellipses that served to exacerbate the technical difficulties involved. 9 refs., 15 figs., 5 tabs.

14894 (CONF-910602–15) **Experience with conventional inelastic analysis procedures in very high temperature applications.** Mallet, R.H. (Mallett Software Technology, Inc., McMurray, PA (USA). Swanson Engineering Div.); Thompson, J.M.; Swindeman, R.W. Oak Ridge National Lab., TN (USA). [1991]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From American Society of Mechanical Engineers (ASME) pressure vessels and piping conference; San Diego, CA (USA); 23-27 Jun 1991. Order Number DE91009937. Source: OSTI; NTIS; GPO Dep.

Conventional incremental plasticity and creep analysis procedures for inelastic analysis are applied to hot flue gas cleanup system components. These flue gas systems operate at temperatures where plasticity and creep are very much intertwined while the two phenomena are treated separately in the conventional inelastic analysis procedure. Data for RA333 material are represented in forms appropriate for the conventional inelastic analysis procedures. Behavior is predicted for typical operating cycles. Creep-fatigue damage is estimated based upon usage fractions. Excessive creep damage is predicted; the major contributions occur during high stress short term intervals caused by rapid temperature changes. These results are presented for discussion of the results and their interpretation in terms of creep-fatigue damage for very high temperature applications. 5 refs., 15 figs., 6 tabs.

14895 (CONF-910602–16) **Reduction factors for creep strength and fatigue life of modified 9 Cr-1 Mo steel weldments: Confirmation by axial or torsional tests of tubular specimens with longitudinal or circumferential welds.** Blass, J.J.; Battiste, R.L.; O'Connor, D.G. Oak Ridge National Lab., TN (USA). [1991]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From American Society of Mechanical Engineers (ASME) pressure vessels and piping conference; San Diego, CA (USA); 23-27 Jun 1991. Order Number DE91009919. Source: OSTI; NTIS; INIS; GPO Dep.

The provisions of ASME B&PV Code Case N-47 currently include reduction factors for creep strength and fatigue life of weldments. To provide experimental confirmation of such factors for modified 9 Cr-1 Mo steel, tests of tubular specimens were conducted at 538°C (1000°F). Three creep-rupture specimens with longitudinal welds were tested in tension; and, of three with circumferential welds, two were tested in tension and one in torsion. In each specimen with a circumferential weld, a nonuniform axial distribution of strain was easily visible. The test results were compared to an existing empirical model of creep-rupture life. For the torsion test, the comparison was based on a definition of equivalent normal stress recently adopted in Code Case N-47. Some 27 fatigue specimens, with longitudinal, circumferential, or no welds, were tested under axial or torsional strain control. In specimens with welds, fatigue cracking initiated at fusion lines. In axial tests cracks grew in the circumferential direction, and in torsional tests cracks grew along fusion lines. The test results were compared to empirical models of fatigue life based on two definition of equivalent normal strain range. The results have provided some needed confirmation of the reduction factors for creep strength and fatigue life of modified 9 Cr-1 Mo steel weldments currently under consideration by ASME Code committees. 8 refs., 5 figs.

14896 (CONF-910614–1) **Creep and creep-rupture behavior of Alloy 718.** Brinkman, C.R.; Booker, M.K.; Ding, J.L. Oak Ridge National Lab., TN (USA). [1991]. 23p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From Special emphasis symposium on superalloys 718, 625, and various derivatives; Pittsburgh, PA (USA); 23-26 Jun 1991. Order Number DE91007706. Source: OSTI; NTIS; INIS; GPO Dep.

Data obtained from creep and creep-rupture tests conducted on 18 heats of Alloy 718 were used to formulate models for predicting high temperature time dependent behavior of this alloy. Creep tests were conducted on specimens taken from a number of commercial product forms including plate, bar, and forgoing material that had been procured and heat treated in accordance with ASTM specifications B-670 or B-637. Data were obtained over the temperature range of 427 to 760°C ad at test times to about 87,000 h. Comparisons are given between experimental data and the analytical models. The analytical models for creep-rupture included one based on lot-centering regression analysis and two based on the Minimum Commitment Method. A "master" curve approach was used to develop and equation for estimating creep deformation up to the onset of tertiary creep. 11 refs., 13 figs.

14897 (CONF-9009353–1) **Order and disorder in metallic alloys.** Gyorffy, B.L. (Bristol Univ. (UK). H.H. Wills Physics Lab.); Stocks, G.M.; Nicholson, D.M.; Ginatempo, B.; Johnson, D.D.; Pinski, F.J.; Staunton, J.B.; Winter, H. Oak Ridge National Lab., TN (USA). [1990]. 26p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From Royal society conference in honor of Prof. V. Heine; London (UK); 5-6 Sep 1990. Order Number DE91009120. Source: OSTI; NTIS; GPO Dep.

The electronic structure of random crystalline metallic alloys is an important chapter in the quantum theory of solids. After atoms, molecules and ordered crystalline solids this is the next most tractable problem of positively charged nuclei and the electron glue between them. Moreover, it is the simplest non-trivial example where the theme of order-disorder is fully developed. In short the electronic states have new features and they drive novel phenomena such as phase separation and compositional ordering. In this talk the authors shall review the current state of the first principles understanding of the electronic structure and the way it determines the compositional short and long range order (de Fountain 1979; Kchaheturyan 1986). Central to the discussion below are two assumptions: one is that of a rigid lattice and the other is that specifying the occupancy variable ξ_i, which takes on the value 1 if there is an A atom at the i-th site and 0 if the atom at $\vec{R}_i$ is the B type, for all sites defines all compositional configurations. The first of these may be relaxed in favor of a symmetry statement, that on the average the system is invariant under a set of translations which define a lattice, without seriously effecting the conceptual framework we are about to describe. Whilst the second, which is essentially the adiabatic theorem, can be relinquished only at the expense of an entirely new start involving diffusion. In short the authors shall consider configurations specified by the sets (ξ_i) and average over all such sets with appropriate weights. 27 refs., 8 figs.

14898 (CONF-9104174–1) **Evaluation of filler metals for high-strength stainless steels.** Swindeman, R.W. (Oak Ridge National Lab., TN (USA)); Goodwin, G.M.; King, J.F.; Lundin, C.D.; Qiao, C.Y.P. Oak Ridge National Lab., TN (USA). [1991]. 19p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 3. international conference on improved coal-fired power plants; San Francisco, CA (USA); 2-5 Apr 1991. Order Number DE91009931. Source: OSTI; NTIS; GPO Dep.

Weldments were produced in types 316, 17-14CuMo, and high strength 14Cr-16Ni-2Mo stainless steel base metals with four filler metals-alloy 82, 17-14CuMo stainless steel, controlled residual element CRE 16-8-2 stainless steel, and alloy 556. The welds were evaluated on the basis of microstructure, strength, and ductility. All of the base metals were prone to hot cracking, but steels high in phosphorus were the most likely to produce poor welds. The CRE 16-8-2 stainless steel filler metal produced the best combination of creep strength and ductility, while alloy 556 produced the best long-time creep strength. Tensile and creep failures usually occurred in the alloy 82, 17-14CuMo stainless steel, or CRE 16-8-2 stainless steel filler metal of weldments tested transverse to the weld. At low temperatures (600 to 700°C) and short times the alloy 556 filler metal usually failed, while at high temperature (700 to 800°C) and long times, the weldment usually failed in the base metal. In weldments creep tested parallel to the welding direction cracking initiated in the CRE 16-8-2 stainless steel filler, even though cracks were observed in the heat-affected zone of the base metal. The mechanical performance of weldments in 14Cr-16Ni-2Mo stainless steel tubing alloys was satisfactory in spite of the observed tendency for cracking. However, it was concluded that further development of the welding technology would be needed before the high-strength alloys would be commercially acceptable. 11 refs., 11 figs., 2 tabs.

14899 (DOE/ER/45265–4) **Optimization of film synthesized rare earth transition metal permanent magnet systems: Progress report, August 1, 1990–March 1991.** Cadieu, F.J. Queens Coll., Flushing, NY (USA). Dept. of Physics. [1991]. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-86ER45265. Order Number DE91010705. Source: OSTI; NTIS; INIS; GPO Dep.

This progress report discusses the following topics: high coercivity Sm-Fe-Ti-V and Sm-Fe-Zr crystalline phases; $ThMn_{12}$ type pseudobinary $SmFe_{12-x}T_x$ (x = 0.5 to 1.5) and even binary $SmFe_{12}$ compound samples; and improved crystal texture control for Re-Tm magnetic films sputtered in Ar-Xe gas mixtures. (LSP)

14900 (DOE/ER/45308–4) **Novel concepts in weld metal science: Role of gradients and composite structure: Progress report, January 1, 1990–December 31, 1990.** Matlock, D.K.; Olson, D.L. Colorado School of Mines, Golden, CO (USA). Center for Welding and Joining Research. Feb 1991. 26p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-87ER45308. (MT-CWR–091-005). Order Number DE91009817. Source: OSTI; NTIS; GPO Dep.

The effects of compositional and microstructural gradients on weld metal properties are being investigated. Crack propagation in solidified alloy structures is being characterized as to solidification orientation and the profile of the compositional variations. Cracking in both Cu-Ni single crystals and high alloy Fe-Cr-Ni alloys are being analyzed. Emphasis is shifted from a consideration of natural gradients, which in weldments and castings are a direct result of solidification induced coring and the thermal history, to an analysis of a new novel class of welds with artificially induced gradients.

The composite modeling techniques are being applied to describe the effects of compositional and microstructural gradients on weld metal properties in alloys. This effort has been extended to the analysis of several new weld metal systems of interest for joining new materials. A specific system of interest utilizes composites which may consist of a soft weld metal with insoluble hard second phase particles. Special techniques to produce laboratory samples with microstructures which simulate the composition and microstructure gradients in solidified weld metal are used, along with appropriate mathematical models, to evaluate the properties of the composite weld metals. 10 refs., 7 figs.

14901 (DOE/ER/45388–1) **Deterministic analysis of processes at corroding metal surfaces and the study of electrochemical noise in these systems: Progress report and summary, 30 November 1989–1 December 1990.** Latanision, R.M. Massachusetts Inst. of Tech., Cambridge, MA (USA). Dept. of Materials Science and Engineering. 1 Dec 1990. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-89ER45388. Order Number DE91009997. Source: OSTI; NTIS; GPO Dep.

Electrochemical corrosion is pervasive in virtually all engineering systems and in virtually all industrial circumstances. Although engineers now understand how to design systems to minimize corrosion in many instances, many fundamental questions remain poorly understood and, therefore, the development of corrosion control strategies is based more on empiricism than on a deep understanding of the processes by which metals corrode in electrolytes. Fluctuations in potential, or current, in electrochemical systems have been observed for many years. To date, all investigations of this phenomenon have utilized non-deterministic analyses. In this work it is proposed to study electrochemical noise from a deterministic viewpoint by comparison of experimental parameters, such as first and second order moments (non-deterministic), with computer simulation of corrosion at metal surfaces. In this way it is proposed to analyze the origins of these fluctuations and to elucidate the relationship between these fluctuations and kinetic parameters associated with metal dissolution and cathodic reduction reactions. This research program addresses in essence two areas of interest: (a) computer modeling of corrosion processes in order to study the electrochemical processes on an atomistic scale, and (b) experimental investigations of fluctuations in electrochemical systems and correlation of experimental results with computer modeling. In effect, the noise generated by mathematical modeling will be analyzed and compared to experimental noise in electrochemical systems. 1 fig.

14902 (EGG-M–90469) **Measurement of particle size, velocity and temperature in the plasma spray coating process.** Fincke, J.R.; Swank, W.D. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1991]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-910684–3: 1. ASME/JSME fluids engineering conference, Portland, OR (USA), 23-26 Jun 1991). Order Number DE91006208. Source: OSTI; NTIS; GPO Dep.

The quality and uniformity of coatings fabricated by the plasma spray process is controlled by the condition of the particles on impact. In this work a measurement technique for simultaneously obtaining particle size, velocity, and temperature is used to characterize the particle spray field. Particle size and velocity are obtained from a combination laser particle sizing system and laser Doppler velocimeter (LDV). The particle temperature is determined by a two-color pyrometer technique and the relative particle number density is derived from the data rate. The fraction of unheated or unprocessed particles which result from temperature and velocity fluctuations is also obtained. This fraction can approach 10% by mass of the total particle flow. 17 refs., 10 figs.

14903 (INIS-mf–12186) **Mechanical long-term properties of nickel-base alloys for steam turbine bolting. Final report.** Kloos, K.H.; Granacher, J.; Loeser, K. Technische Hochschule Darmstadt (Germany, F.R.). Fachgebiet Werkstoffkunde; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 20 Dec 1990 46p. Contract COST 501-II, WP3(I), D3;BMFT 03K13035. Order Number DE91769178. Source: OSTI; NTIS (US Sales Only); INIS.

Within the reported project three heat resistant nickel-base alloys, Alloy 70 (NiCr 20 Fe 25 TiAl), Alloy 80A (NiCr 20 TiAl) and Alloy X-750 (NiCr 15 TiAl) were investigated for the application to steam turbine bolting in the temperature range of 450 to 600deg C. Important mechanical long-term properties as creep-rupture strength, relaxations strength and contraction were determined to improve the basis for the optimum selection of bolting materials. On the optimized condition of the three materials, some important interdependencies between different mechanical properties were investigated. Using creep and contraction data, it was possible to predict the time-dependent residual stress of the continuous relaxation test with sufficient accuracy. An inelastic finite element calculation of notched specimens of Alloy 80A for 550deg C short-term creep-rupture tests showed, that even under elastoplastic loading there is a risk to crack initiation in the vicinity of the notch. (orig./RHM) With 17 figs., 15 tabs.

14904 (INIS-mf–12807, pp. 6.26-6.28) **Analysis of container failures in a geologic repository: Mathematical modeling of container pitting.** Kim, Chang-Lak (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)); Kim, Jhin-Wung; Suh, In-Suk. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

Pitting corrosion in low-carbon steel canisters cannot be ruled out. Pitting of steel containers in contact with aerated groundwater is modeled mathematically. The relatively slow diffusion rate of oxygen will control the rate of corrosion if the inward diffusion of the dissolved oxygen occurs to compensate the oxygen consumption at the cathode. The equation for time-dependent pit penetration is derived. The pit penetrates deeply if the area ratio of the pit and the metal surface outside the pit is small.

14905 (INIS-SU–238/A, pp. 6-8) **Impurity microprecipitates in silicon.** Ibraev, B.M. (and others); Il'ina, E.G.; Kalyuzhnaya, G.A. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989. 56p. (In Russian). In *Plasma physics: Collection.* Order Number DE91003082. Source: OSTI; NTIS (US Sales Only); INIS.

Volumetric microinhomogeneities of various type in production silicon crystals, grown by Czochralski and creecible-free zone melting methods, are detected using scattering of very cold neutrons, laser mass-spectrometry, secondary ion mass spectroscopy.

14906 (INIS-SU–240, pp. 49-55) **Peculiar features of vanadium as low-activated materials for thermonuclear reactors.** Votinov, S.N.; Gomozov, L.I.; Dedyurin, A.I.; Zavyal'skij, L.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 75p. (In Russian). In *Thermonuclear synthesis: Scientific-technical collection.* Order Number DE91003079. Source: OSTI; NTIS (US Sales Only); INIS.

The factors, controlling the application of vanadium alloys has been analyzed. The results of corrosion effect of lithium, sodium (at 700 deg C) and water vapour (up to 500 deg C) has been studied. Correlation between phase constitutional diagrams and radiation swelling rates has been shown. It has been shown that high temperature radiation brittleness is affected by structure of alloys. 23 refs.; 6 figs.; 3 tabs.

14907 (JAERI-M–90-191) **Generation of draft of design yield strength Sy and design tensile strength Su on aluminum and aluminum alloys for research reactors.** Tsuji, Hirokazu (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Kakefuda, Kazuhiro; Nakajima, Hajime. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 134p. (In Japanese). Order Number DE91767892. Source: OSTI; NTIS (US Sales Only); INIS.

The Science and Technology Agency is planning to develop a design code for research reactors. In the code aluminum and aluminum alloys will be admitted as structural materials. Though the material strength standards such as the design yield strength Sy, the design tensile strength Su and the design fatigue curve for those materials are needed in order to use them in 'design by analysis', they have not been determined yet at the moment. From

such a background, Japan Atomic Energy Research Institute (JAERI) and Power Reactor and Nuclear Fuel Development Corporation (PNC) played the major roles in obtaining the necessary material data and in analyzing them statistically. This report describes the tension test program, the experimental methods, the obtained data, the applied statistical data analyses and the proposed Sy/Su. (J.P.N.).

14908 (KFK–4266) **Stability of force flow cooled superconductors under various cooling conditions.** Bonmann, D. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Technische Physik; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Physik. Jul 1987. 156p. (In German). Order Number DE91764552. Source: OSTI; NTIS (US Sales Only); INIS.

The stability of two force flow cooled multifilamentary NbTi superconductors (Cu/sc = 4 and 4.8, diam. 1.92 and 3 mm) against local heat pulses with a duration of 0.3 ms has been measured. Stability is expressed by the critical energy, which is the minimum energy leading to the propagation of a normal-conducting zone. The main objective of this work is the investigation of the connection between transient heat transfers, which depend on pressure and flow velocity, and critical energy. The helium pressure inside the cooling channels is 1 to 5 bar, the temperature 4 to 6 K and the Reynold's number of the forced flow varies from 0 to 60000. Existing models and correlations for the various consecutive phases of heat transfers to helium at 1 bar and for supercritical helium are discussed and extrapolated to the vicinity of the critical pressure for a computer simulation of stability. Fair agreement of the computer simulation - without adjustable parameters - and the experiment is achieved as long as heat transfer mechanisms remain nonconvective. As long as convection is of negligible influence only a helium boundary layer of at most 50 μm contributes to stability, independently of pressure or flow velocity. For currents close to I_c a forced flow hardly changes critical energy; therefore a flow which is just sufficient to maintain the conductor temperature constant is adequate for the stabilization of the superconductor. (orig.).

14909 (KFK–4823) **Crack propagation behaviour in stainless steel AISI 316L at elevated temperatures under static and cyclic loading.** Lange, H. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau. Jan 1991. 187p. (In German). Order Number DE91769169. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental investigations of crack growth under creep and creep-fatigue conditions are presented. The experiments were performed with the austenitic steel AISI 316L, that will be used in fast breeder reactors. A comparison of crack propagation behaviour at temperatures of T = 550deg C and T = 700deg C in common through-thickness cracked specimens and in plates containing surface cracks is carried out by application of several fracture mechanics parameters. The quantitative description of crack initiation times and crack velocities is persued particularly. The propagation rate of one-dimensional cracks under cyclic loading conditions at T = 550deg C is also treated with fracture mechanical methods. The influence of the hold periods on crack speed is discussed. (orig.).

14910 (KI–90-6) **Corrosion in sea water at different depths.** Sund, G. Swedish Corrosion Inst., Stockholm (Sweden). 17 May 1990. 66p. (In Swedish). Order Number DE91763543. Source: OSTI; NTIS (US Sales Only).

With summary in English.

The sea and the sea bottom contain great resources which only during the last decades have begun to be used to any great extent. In this connection, stationary constructions for oil and gas extraction attract great interest, but floating factories, plants for water usage and desalting plants can also be mentioned. The ultimate goal of the project was to provide a comprehensive picture of how the corrosion rate varies at different depths in sea water by: - determining the risk for local corrosion of stainless steels. - determining the corrosion rate during the general corrosion of carbon steel and low alloy steels and the risk of hydrogen embrittlement of welded high-tensile steels. - studying galvanic effects when stainless steels/titanium are joined to carbon steel, Ni-resist and copper alloys. The investigation was carried out in the Koster fiord at a depth of ca 10 m and at a depth level corresponding to 130 m and at the Norske Veritas test station outside Bergen at depths of 10 m and 110 m. A lot of information concerning sea water parameters and growth was obtained and compiled for the different test sites. A large amount of data are presented in the report. (16 figs., 21 tabs., 12 refs.).

14911 (LA-UR–91-884) **Electrodeposited coatings for diamond turning applications.** Mayer, A. (Los Alamos National Lab., NM (USA)); Bramlett, R.D.; Day, R.D.; Evans, C.J.; Polvani, R.S. Los Alamos National Lab., NM (USA). [1991]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9104206–1: American Society for Precision Engineering conference, Tucson, AZ (USA), 15-18 Apr 1991). Order Number DE91009950. Source: OSTI; NTIS; GPO Dep.

Electrodeposited coatings are attractive for precision machining operations because thick coatings can be economically applied, with good adhesion, to a variety of substrates. Approximately 20 pure metals and a large number of alloys can be deposited from aqueous solutions. Fused salt and organic solvent electrolytes can be used to lengthen the list of metals that can be electrodeposited. However, both the choice of the metallic coating and the control of the plating process are critical for success in precision finishing of electrodeposited coatings. Some preliminary results at the National Institute of Standards and Technology and at the Lawrence Livermore National Laboratory suggest that electrodeposited nickel-phosphorus alloys are excellent coatings for single point diamond turning from the standpoint of material properties and low tool wear. Electrodeposited aluminum and aluminum alloy coatings also merit consideration for precision finishing where weight is an important factor. 10 refs., 6 figs.

14912 (LBL–29595) **Electricity end use demand study for Egypt.** Turiel, I.; Lebot, B.; Nadel, S.; Pietsch, J.; Wethje, L. Lawrence Berkeley Lab., CA (USA). Dec 1990. 142p. Sponsored by Agency for International Development, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010224. Source: OSTI; NTIS; GPO Dep.

This report describes the results of a study undertaken by Lawrence Berkeley Laboratory (LBL) to develop an approach for reducing electricity demand in the residential sector in Egypt. A team with expertise in appliance energy usage, appliance manufacturing, appliance testing, and energy analysis was assembled to work on this project. The team visited Egypt during the month of March 1990. They met with the Egyptian Organization for Energy Planning (OEP) and with many other parties. They also visited eleven appliance manufacturing facilities. The project tasks are: data gathering and analysis; assessment of appliance manufacturing plants; demonstration of microcomputer programs; gathering of data on appliance standards and test procedures; and impact of programs to foster energy efficiency of electricity use.

14913 (LBL–30170) **Cryogenic mechanical behavior of Vintage 3 aluminum-copper-lithium alloy 2090-T81.** Chu, D. (California Univ., Berkeley, CA (USA). Dept. of Materials Science and Mineral Engineering). Lawrence Berkeley Lab., CA (USA). Dec 1990. 100p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91009776. Source: OSTI; NTIS; GPO Dep.

The cryogenic mechanical properties of a 12.7 mm (0.5 in.) Vintage 3 2090-T81 (Al-3.05Cu-2.16Li-0.11Zr in weight percent) plate material are studied. The results indicate that the through-thickness and in-plane anisotropies in the yield strength of Vintage 1 2090-T81 are reduced in the Vintage 3 material by utilizing a partial recrystallization step during the thermomechanical processing, but at some cost to the elongation and cryogenic fracture toughness. Sharp discontinuities in the microstructure resulting from this thermomechanical treatment give rise to distinct differences in the variation of the work hardening behavior with temperature between those regions that undergo recrystallization and those that do not. In-plane properties are also affected by the wide variation in grain structure; the fully unrecrystallized region exhibit greater in-plane anisotropy than the pre-crystallized region. The lower elongations relative to Vintage 1 2090-T81 observed in Vintage 3 2090-T81 result from a decrease in work hardenability that appears to be associated with increased slip heterogeneity. The reduced cryogenic

toughness is due in part to the disruption of the monolithic unrecrystallized grain structure previously observed in Vintage 1 2090-T81. The results suggest that a fully unrecrystallized structure is essential for excellent cryogenic toughness. 53 refs., 66 figs., 9 tabs.

14914 (LBL–30254) **The strength and toughness of stainless steels at cryogenic temperature.** Morris, J.W. Jr. Lawrence Berkeley Lab., CA (USA). Jan 1991. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-9106130–2: Stainless steels '91, Chiba (Japan), 10-13 Jun 1991). Order Number DE91009771. Source: OSTI; NTIS; GPO Dep.

The mechanical criterion that most often governs the use of stainless steels at cryogenic temperature is the combination of yield strength and fracture toughness. The strength-toughness combination depends on the fracture mode, which should be ductile. The toughness in the ductile mode is affected by the strength, the tensile properties, and the inclusion density. To maximize toughness, the alloy should have a high work hardening rate and a low inclusion count. The toughness of metastable austenitic steels is governed by a balance between stress relaxation by the strain-induced martensitic transformation and the brittleness of the fresh martensite. This balance also governs the response of metastable steels to a high magnetic field; the toughness of relatively stable steels increases when a field is imposed, while that of relatively unstable steels decreases. 7 refs., 4 figs.

14915 (PINSTECH/NPD–126) **Segregation in welded nickel-base alloys.** Akhtar, J.I.; Shoaib, K.A.; Ahmad, M.; Shaikh, M.A. Pakistan Inst. of Nuclear Science and Technology, Islamabad (Pakistan). Nuclear Physics Div. May 1990. 18p. Order Number DE91624373. Source: OSTI; NTIS (US Sales Only); INIS.

8 fig.

Segregation effects have been investigated in nickel-base alloys monel 400, inconel 625, hastelloy C-276 and incoloy 825, test welded under controlled conditions. Deviations from the normal composition have been observed to varying extents in the welded zone of these alloys. Least effect of this type occurred in Monel 400 where the content of Cu increased in some of the areas. Enhancement of Al and Ti has been found over large areas in the other alloys which has been attributed to the formation of low melting slag. Another common feature is the segregation of Cr, Fe or Ti, most likely in the form of carbides. Enrichment of Al, Ti, Nb, Mb, Mo, etc., to different amounts in some of the areas of these materials is in- terpretted in terms of the formation of gamma prime precipitates or of Laves phases. (author). 8 fig.

14916 (PINSTECH/NPD–128) **Swelling in nickel - carbon and nickel - silicon alloys.** Shaikh, M.A.; Ehrlich, K. Pakistan Inst. of Nuclear Science and Technology, Islamabad (Pakistan). Nuclear Physics Div.; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung. Sep 1990. 39p. Order Number DE91625635. Source: OSTI; NTIS (US Sales Only); INIS.

13 fig.

In this report experimental results of a study of the effects of solute elements, carbon and silicon, on swelling in nickel irradiated with 100 KeV nickel ions to a dose of 18 dpa at 625 degree C using transmission electron microscopy are presented. Solute atoms suppress formation of voids in nickel by reducing void nucleation rate. Silicon is found to be more effective than carbon. Effect of temperature in the range 475-675 degree C and that of dose (9.9, 19.7 and 39 dpa) on swelling in nickel were also investigated. Void number density increases with increasing temperature, reaches a maximum and then decreases. Average void diameter increases with increasing temperature except for the lowest dose (9.9 dpa) in which case it remains constant above 575 degree C. Dislocation loops coexist with voids at 475 degree C nd 525 degree C at dose of 9.9 dpa. Swelling in- creases with increasing temperature, reaches a maximum and then decreases. No voids were observed in Ni-3.6% at any temperature and dose. (author). 13 fig.

14917 (RISO-M–2888) **Metallurgy Department publications 1989.** Horsewell, A. (ed.). Risoe National Lab., Roskilde (Denmark). Metallurgy Dept. Aug 1990. 44p. Order Number DE91624293. Source: OSTI; NTIS (US Sales Only); INIS.

All publiclations by the staff of the Metallurgy Department during 1989 are listed. This list is divided into three sections as follows: Publications (journal and conference papers, reports); Lectures (public lecture presentations) and Posters (poster presentations at conferences and symposia). Abstracts are included. (author).

14918 (SAND–91-0499C) **The solidification behavior of an Alloy 625/718 variant.** Cieslak, M.J. Sandia National Labs., Albuquerque, NM (USA). [1991]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910614–2: Special emphasis symposium on superalloys 718, 625, and various derivatives, Pittsburgh, PA (USA), 23-26 Jun 1991). Order Number DE91009544. Source: OSTI; NTIS; GPO Dep.

The solidification behavior of Custom Age 625 PLUS® is examined using an integrated analytical approach. Like its predecessors, Alloys 625 and 718, the solidification behavior of this new alloy is dominated by the presence and segregation of Nb, which gives rise to a γ/Laves terminal solidification constituent. 8 refs., 5 figs., 2 tabs.

14919 (SIEMENS-KWU-TW–1187/89) **Investigations on crack initiation and propagation under static, cyclic and combined loading conditions of 1% CrMoNiV-steels at 530deg C. Final report.** Ewald, J.; Berger, C.; Brachvogel, H. Siemens AG Unternehmensbereich KWU, Muelheim an der Ruhr (Germany, F.R.). Bereich Technik, Werkstoffe; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 29 Jun 1989. 74p. (In German). Contract BMFT 03K05110;COST 505-D20/D21. Order Number DE91764551. Source: OSTI; NTIS (US Sales Only); INIS.

Two 1% CrMoNiV steels were tested at room temperature, 530 and 550deg C normally with CT1 specimens. The material was in the as-received and aged condition (simulating the conditions up to 100,000 h at 530deg C). The crack lengths were measured by potential drop for cycling and static loading conditions in the single tester at the test temperature and in the multiple test machine during unloading of specimen with compliance technique. To compare the test procedure and the evaluation of results, a Round Robin test at 550deg C was performed to measure the cyclic crack growth rate under static loading. For measurements of creep crack growth rates, a lot of specimens were tested (up to about 20,000 h) at 530deg C. With increasing stress intensity factor (K_{Iid}) decreases the time for crack initiation. The crack growth rates increased too with increasing load, e.g. stress intensity factor (K_{Iid}). The results allow an estimation of crack under creep loading conditions with respect to crack initiation and crack growth. The fatigue crack growth under cyclic loading (R = 0.1) at different frequencies (10, 1 and 0.017 Hz) at a temperature of 530deg C shows an increasing of crack growth rate with increasing time per cycle. (orig./MM).

14920 (UCRL-CR–106146) **Modeling second-phase formation during rapid resolidification of stainless steel alloys.** Elmer, J.W. (Lawrence Livermore National Lab., CA (USA)); Eagar, T.W.; Allen, S.M. Lawrence Livermore National Lab., CA (USA). 28 Jan 1991. 10p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Contract N00014-80-C-0384. (CONF-9106130–1: Stainless steels '91, Chiba (Japan), 10-13 Jun 1991). Order Number DE91008567. Source: OSTI; NTIS; GPO Dep.

Many common stainless steel (SS) alloy microstructures consist of a mixture of ferrite and austenite phases, however, when these alloys are rapidly resolidified using laser beam (LB) or electron beam (EB) processes they solidify in the single-phase-austenite or single-phase-ferrite mode. This paper investigates the influence of solidification rate on the reduction, and eventual elimination, of second phases during the rapid solidification of SS alloys. The influence of solidification rate on the ferrite content of these alloys was studied by calculating the dendrite-tip undercooling and then incorporating these results into a solute-redistribution model to calculate the relative fractions of primary and secondary phase that solidify from the melt. Single-phase solidification was predicted at high cooling rates and was confirmed through STEM analysis, showing solidification microstructures void of any significant microchemical composition gradients. Results showed a rapid-solidification model was used to calculate the relative fractions of primary and secondary phases that form during the resolidification

of stainless steel alloys. The rapid-solidification model shows that the ferrite content of primary-austenite solidified alloys decreases and the ferrite content of primary-ferrite solidified alloys increases with increasing cooling rate. Results of the model indicate that primary-austenite alloys will solidify in the single-phase mode at all interface velocities greater than about 20 mm/s. This value correlates well with experiments. Results of the model indicate that primary-ferrite alloys will solidify in the single-phase mode at all interface velocities greater than about 50 mm/s. The experimentally-observed interface velocity for single-phase-ferrite solidification is significantly less (10 mm/s). This discrepancy is proposed to be related to the relative difficulty of nucleating austenite from the eutectic liquid. 13 refs., 5 figs., 2 tabs.

14921 (UCRL-JC-106552) **Fracture behavior of warm forged and CVD tungsten.** Lassila, D.H.; Connor, A. Lawrence Livermore National Lab., CA (USA). 14 Feb 1991. 21p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910202-8: Annual meeting and exhibition of the Minerals, Metals and Materials Society (TMS), New Orleans, LA (USA), 17-21 Feb 1991). Order Number DE91009756. Source: OSTI; NTIS; GPO Dep.

The fracture behavior of warm forged and chemical vapor deposition (CVD) tungsten was studied. Three-point bend tests were used to determine ductile-brittle transition temperatures (DBTT) of the materials using a strain based criterion for the DBTT which was arrived at by analysis of computer code modelling results of the three-point bend test. The DBTT's of the warm forged materials were found to be considerably lower than those of the CVD materials. Scanning electron microscopy (SEM), scanning Auger electron spectroscopy (SAES) and X-ray photoelectron spectroscopy (XPS) were performed to characterize the fracture morphologies and fracture surface compositions of the materials. All fracture surfaces were found to be comprised entirely of tungsten with significant and varying amounts of oxygen and carbon segregation. A large portion of the fracture surfaces of the warm forged materials is intergranular, although this is not always directly evident from SEM observations. The fracture surfaces of the CVD materials were clearly 100% intergranular. Results of the study suggest that the fracture paths of the different materials were related to the DBTTs. 22 refs., 8 figs., 2 tabs.

3602 Ceramics, Cermets, and Refractories

Refer also to citation(s) 13947, 14413, 14702, 14766, 14768, 14769, 14770, 14771, 14772, 14773, 14874, 14917, 14951, 14987, 15068, 15829

14922 (ANL-90/47) **Practical superconductor development for electrical power applications: Annual report for FY 1990.** Goretta, K.C. (comp.). Argonne National Lab., IL (USA). Oct 1990. 41p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. Order Number DE91010015. Source: OSTI; NTIS; GPO Dep.

Development of useful high-critical-temperature (high-T_c) superconductors requires synthesis of superconducting compounds; fabrication of wires, tapes, and films from these compounds; production of composite structures that incorporate stabilizers or insulators; and design and testing of efficient components. This report describes technical progress of research and development efforts aimed at producing superconducting components based on the Y-Ba-Ca, Bi-Sr-Ca-Cu, Bi-Pb-Sr-Ca-Cu, and Tl-Ba-Ca-Cu oxide systems. Topics discussed are synthesis and heat treatment of high-$T_c$superconductors, formation of monolithic and composite wires and tapes, superconductor/metal connectors, characterization of structures and superconducting and mechanical properties, and fabrication and properties of thin films. Collaboration with industry and academia is also documented. 42 refs., 18 figs., 3 tabs.

14923 (ANL/CP-71063) **Sintering and hot isostatic pressing of $Bi_2Sr_2CaCu_2O_x$.** Nash, A.S. (Marquette Univ., Milwaukee, WI (USA)); Nash, P.; Poeppel, R.B.; Goretta, K.C. Argonne National Lab., IL (USA). Jan 1991. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-910212-4: High-temperature superconductors: processing and microstructure property relationships, New Orleans, LA (USA), 17-21 Feb 1991). Order Number DE91010797. Source: OSTI; NTIS; GPO Dep.

The $Bi_2Sr_2CaCu_2O_x$ phase was synthesized by solid-state reaction of oxides and carbonates. Initial compositions of Bi:Sr:Ca:Cu were 4:3:3:6 and 2:1.7:1:2. Pellets of the pure powder and powder containing 2.5, 5, or 15 wt % Ag were cold-pressed and either sintered or hot isostatically pressed (HIPped). For HIPping, the pellets were encased in thin Ag sheets, canned in steel, and pressed at 105 MPa in argon at 800 or 850°C. HIPping produced dense specimens, but sintering did not. HIPping induced very little decomposition of the $Bi_2Sr_2CaCu_2O_x$, but a post-HIP anneal was needed to raise the transition temperature above 80 K. The Ag additions appeared to minimize microcracking during HIPping at 800°C. Little microcracking was evident in any of the specimens HIPped at 850°C. 22 refs., 4 figs.

14924 (BNL-45806) **Theory of the critical current density in $YBa_2Cu_3O_7$ ceramics.** Cai, Zhi-Xiong; Welch, D.O. Brookhaven National Lab., Upton, NY (USA). [1991]. 5p. Sponsored by US-DOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-910298-1: 4. annual workshop on the recent development of computer simulation studies in condensed matter physics, Athens, GA (USA), 18-22 Feb 1991). Order Number DE91009443. Source: OSTI; NTIS; GPO Dep.

One of the stumbling blocks in the practical application of the high $T_c$ceramic materials is their low critical current densities as compared to typical values for single crystals and epitaxial thin films. It is generally believed that the predominate factor limiting the critical current is the "weak-link" behavior of the superconducting current at grain boundaries. Grain alignment has been used to obtain favorable orientations of the grains and/or obtain favorable grain boundaries. In this paper we study the case where the c-axes of the grains are aligned, in a common direction. This type of alignment is obtained by a variety of techniques, such as the application of a uniaxial pressure during processing or magnetic alignment of powder particles. In these samples the relative orientation of the two grains at grain boundaries involves a rotation about the c-axis. Conduction across these boundaries would be within the ab-plane, which has a larger coherence length than that in c-axis.

14925 (CONF-9104187-1) **Two-channel spectroscopic polarization modulation ellipsometry: A new technique for the analysis thin SIOsub 2 films.** Jellison, G.E. Jr. Oak Ridge National Lab., TN (USA). Mar 1991. 22p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From International conference on metallurgical coatings and thin films; San Diego, CA (USA); 22-26 Apr 1991. Order Number DE91010131. Source: OSTI; NTIS; GPO Dep.

A new spectroscopic ellipsometer is described, where the incoming light is dynamically polarized using a photoelastic modulator, and the reflected light is separated into orthogonally polarized beams using a Wollaston prism. Both beams are detected using photomultiplier tubes whose bias voltage is dynamically controlled for constant dc. All three of the associated ellipsometry parameters ($N = \cos 2\psi$, $S = \sin 2\psi \sin\Delta$, $C = \sin 2\psi \cos\Delta$) can be determined simultaneously in a single scan (240-840 nm or 5.16-1.47 eV). This instrument has been used to study the optical properties of thin SiO_2 films from 3 to 325 nm in thickness. Using a biased estimator fitting technique, the raw ellipsometric data can be fit to an air-SiO_2-interface-Si model, where the optical functions of the SiO_2 layer and the interface region are approximated using a one-term Sellmeier approximation, and a 50% voids, 50% SiO_2 Bruggeman effective medium approximation, respectively. The refractive index of the SiO_2 layer is dependent on film thickness, increasing with decreasing film thickness, but always being greater than fused quartz. The thickness of the interfacial region increases with increasing film thickness, being less than 0.2 nm for film thicknesses <20 nm. 17 refs., 6 figs., 1 tab.

14926 (CONF-9105138-1) **Chevron-notched, flexure tests for measuring the elevated temperature fracture resistance of structural ceramics.** Jenkins, M.G. (Oak Ridge National Lab., TN (USA)); Ferber, M.K.; Ghosh, A.; Peussa, J.T.; Salem, J.A. Oak Ridge National Lab., TN (USA). [1991]. 28p. Sponsored by US-DOE, Washington, DC (USA). DOE Contract AC05-84OR21400.

From Chevron-Notch fracture test experience metals and nonmetals conference; Indianapolis, IN (USA); 6 May 1991. Order Number DE91009117. Source: OSTI; NTIS; GPO Dep.

Chevron-notched, three-point flexure specimens were used to study the quasi-static fracture behaviour of a variety of structural ceramics at temperatures to 1400°C. Types of materials tested included monolithic ceramics (SiC, Si_3N_4, $MgAl_2O_4$), self-reinforced monoliths (acicular grained Si_3N_4, acicular grained mullite), and ceramic matrix composites (SiC whisker/Al_2O_3 matrix, TiB_2 particulate/SiC matrix, SiC fibre/CVI SiC matrix, Al_2O_3 fibre/CVI SiC matrix). Fracture resistance behaviour of thee materials was quantified as three distinct regimes of the fracture histories. At crack initiation, the apparent fracture toughness was evaluated as the critical stress intensity factor, K_{IC}. During stable crack propagation, the crack growth resistance was characterized by the instantaneous strain energy release rate, G_R, using a compliance method assuming linear-elastic unloading to calculate the effective crack lengths. At final fracture, the complete fracture process was quantified using the work-of-fracture, γ_{WOF}, which can be equated to the fracture surface energy for linear-elastic materials. Results indicate that the chevron-notched, three-point flexure specimen facilitates the study of fracture behaviour in a wide range of brittle and quasi-brittle materials at elevated temperatures. The unique features of the chevron geometry, which are automatic crack initiation and inherent stable crack growth are crucial to the successful evaluation of the fracture tests. 25 refs., 10 figs., 3 tabs.

14927 (INIS-SU–237, pp. 48-49) **Electron and gamma irradiation effects on properties of high temperature oxide metal ceramics.** Georgobiani, A.N. (and others); Gutan, V.B.; Derid, Yu.O. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989. 58p. (In Russian). In *Experimental and theoretical physics: Collection.* Order Number DE91003081. Source: OSTI; NTIS (US Sales Only); INIS.

It is stated that 3.5-4 MeV electron and gamma irradiation of $YBa_2Cu_3O_{7-x}$ ceramics causes appearance of a step on resistivity temperature dependence and cathodoluminescence band intensity growth with maxima at 2.6; 3.31; 3.36 eV (T=80K) energies. 3 refs.; 2 figs.

14928 (INIS-SU–240, pp. 55-58) **Measurement of partial coefficients of sputtering of titanium atoms from TiC and TiN coatings.** Vychegzhanin, G.A.; Gribanov, Yu.A.; Dikij, N.P.; Zhmurin, P.N.; Letuchij, A.N.; Matyash, P.P.; Sidokur, P.I.; Shono, D.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 75p. (In Russian). In *Thermonuclear synthesis: Scientific-technical collection.* Order Number DE91003079. Source: OSTI; NTIS (US Sales Only); INIS.

Method of laser fluorescent spectroscopy was used to measure partial coefficients of sputtering of titanium atoms from TiC and TiN coatings under irradiation by 1 keV hydrogen ions. Irradiation was conducted in a plant with reflective discharge. Investigation of damaged layer in irradiated samples was conducted. The presence of near-the-surface layer enrichment with titanium atoms was revealed both in TiC and TiN samples. 12 refs.; 4 figs.

14929 (Juel–2380) **Investigations on structure and thermomechanical behaviour of special silicon carbide grades in respect to their application in fusion reactors.** Brandstaedter, A.; Koizlik, K.; Linke, J.; Nickel, H. Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Reaktorwerkstoffe; Technische Hochschule Aachen (Germany, F.R.). Sep 1990. 142p. (In German). Order Number DE91769004. Source: OSTI; NTIS (US Sales Only); INIS.

Dissertation submitted by A. Brandstaedter.

Low Z-ceramics such as SiC are potential material candidates for plasma facing components in thermonuclear fusion reactors. To prove the applicability of ceramics it is necessary to analyse the fracture strength and to characterize the fracture mechanisms. Therefore the quantitative characterization of the structure and the analysis of the fracture surfaces are investigated and in addition the 4- point-bending strength is tested for three different SiC-qualities. To investigate the thermomechanical behaviour of these materials, high heat flux experiments are carried out using a 15 kW electron beam machine. A set of samples are exposed to heat loads to obtain information about the influence of thermal shocks on the fracture strength. Two different loading scenarios are simulated, a quasi stationary and a pulsed one, which are realized with a slowly rotating beam and a fast rotating beam. The results indicate that the fracture strength of the loaded samples is reduced in comparison to the as-received material and depends on the loading conditions. These results are confirmed by investigating the position of crack initiation, the morphology and the roughness of the fracture surfaces. (orig.).

14930 (LA-UR–91-887) **Microstructure of epitaxial $YBe_2Cu_3O_7$ thin films.** Mitchell, T.E. Los Alamos National Lab., NM (USA). [1990]. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-901125–11: 2. international ceramic science and technology congress, Orlando, FL (USA), 12-15 Nov 1990). Order Number DE91009951. Source: OSTI; NTIS; GPO Dep.

Thin epitaxial films of $YBa_2Cu_3O_7$ on single crystal substrates have been prepared in situ by laser ablation and by post situ annealing of evaporated films of Cu, Y and BaF_2. Substrates include (001) $SrTiO_3$, $LaGaO_3$, and $LaAlO_3$. For both in situ and post situ annealed films, epitaxial (001) grains of $YBa_2Cu_3O_7$ form near the substrate but (100) and (010) grains tend to nucleate for thicknesses greater than $\sim 0.5\mu m$. 90° grain boundaries are therefore common, as well as other defects such as small angle boundaries dislocations and stacking faults. High resolution electron microscopy of the substrate/superconductor interface shows regions of perfect epitaxy, distorted areas, amorphous regions and areas of interdiffusion. The relationship of observed microstructure to critical current density is discussed. 21 refs., 15 figs.

14931 (LA-UR–91-892) **Re-analysis of photoemission data for CuO: Revision of the configuration-energy scheme for cuprate materials.** Brandow, B.H. Los Alamos National Lab., NM (USA). [1991]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910145–3: Electronic structure and mechanisms for high temperature superconductivity, Coral Gables, FL (USA), 3-9 Jan 1991). Order Number DE91009952. Source: OSTI; NTIS; INIS; GPO Dep.

The author has recently carried out a very careful analysis of photoemission and inverse photoemission (BIS) data for CuO, probably the most refined and thorough such analysis for any transition-metal compound to date. This has led to a configuration-energy scheme for cuprate materials which is quite different from a generally-accepted one, due largely to Sawatzky and co-workers. For example, it is commonly believed that the doping holes in $La_{2-x}Sr_xCuO_4$ are hosted almost entirely within oxygen 2p orbitals. He finds instead that these holes are shared roughly equally by 2p and 3d orbitals. In this report he shall sketch the motivations for this study the main results, and some of the lessons and surprises encountered along the way. 22 refs., 1 fig.

14932 (LA-UR–91-964) **Fermi surface of YBCO by DHVA.** Smith, J.L.; Fowler, C.M.; Freeman, B.L.; Hults, W.L.; King, J.C.; Mueller, F.M. Los Alamos National Lab., NM (USA). Jan 1991. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910190–2: Workshop on electronic structures and mechanisms for high temperature superconductivity, Miami, FL (USA), 3-9 Jan 1991). Order Number DE91009963. Source: OSTI; NTIS; INIS; GPO Dep.

These proceedings demonstrate how far scientist have come in the last four years of high temperature superconductivity. Knowledge of the energy bands and Fermi surfaces from experiment has come rather late. Photoemission, first showed proof of the validity of the energy band calculations. Positron annihilation, presented by West, after a rough start, is now giving evidence of the Fermi surface. Both of these techniques involve electronic excitations and hence, although they show the Fermi surface, do not put as severe a constraint on various models for superconductivity as does the de Haas-van Alphen (dHvA) effect. This is a true measurement of the electronic ground state in an applied magnetic field where the frequency of oscillatory magnetization yields extremal cross-sectional areas of the Fermi surface. The authors have already reported some of their Fermi surface work at two conferences but present here discussion of several more important aspects of the work. 11 refs., 2 figs.

14933 (LBL–30220) **Dopant effects on sintering behavior in ceramic matrix composites.** Brown, G.L. Lawrence Berkeley Lab., CA (USA). Dec 1990. 69p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91009774. Source: OSTI; NTIS; GPO Dep.

Heterogeneities present one of the most serious problems in the processing of ceramic bodies. Non-uniformities in a ceramic, such as agglomerates, rigid inclusions, a wide particle size or pore size distribution, or spatial variations in green density can seriously affect sintering behavior, and experiments performed on highly uniform powder compacts have proven the importance of homogeneity within the compact. Powder compacts produced by conventional processing techniques, however, usually contain at least some of the inhomogeneities mentioned above. Particulate ceramic composites are currently being studied a great deal because of their improved fracture toughness and high-temperature creep resistance over single-phase ceramics. The presence of an inert second phase, however, has been found to hinder the densification of the matrix material seriously, even at low volume fractions of the inclusion phase, in a way that is to data not fully understood. Such techniques as hot pressing, hot isostatic pressing, or the incorporation of liquid-phase forming additives must therefore be used to obtain theoretical or near-theoretical densities; however it would be more convenient and more economical to free sinter these composites to full density. It is therefore important to obtain an understanding of the exact effects of heterogeneities on sintering, so that these effects may be countered. In this study, an attempt was made to more fully understand the effects of rigid, non-sinterable inclusions on densification in the ZnO-SiC system.

14934 (PNL-SA–18573) **Stress-density variations in alumina sediments: Effects of polymer chemistry.** Schilling, C.H.; Lanutti, J.J.; Shih, W.H.; Aksay, I.A. Pacific Northwest Lab., Richland, WA (USA). Jan 1991. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. (CONF-901273–3: Materials Research Society meeting, Boston, MA (USA), Dec 1990). Order Number DE91009055. Source: OSTI; NTIS; GPO Dep.

Achieving spatially uniform, high density microstructures during the shape-forming of colloidal ceramics is paramount for eliminating packing structure heterogeneities that impair physical properties of ceramics after sintering. The maximum density obtainable for a given sample depends largely on (1) the magnitude of the effective stresses and (2) plastic properties, which in turn are significantly altered by processing parameters affecting interparticle friction and adhesion. To quantify the effects of processing parameters on consolidation, the authors present a novel approach for analyzing sediments by gamma-ray densitometry and a fluid mechanics model. This method enables them to correlate processing parameters with spatial variations of the packing density and the local effective stress. Significant variations in plasticity can arise through modification of interparticle forces by changing the chemistry of surface-adsorbed polymers or ions. In the present study, they address the question of how to design surface-adsorbed polysiloxanes to enhance particle rearrangement into densely packed structures. Polysiloxanes are excellent lubricants (e.g. silicon oil) due to the low rotational energy of the Si-O-Si bonds comprising the polymer backbone. These inorganic polymers are also available with a broad range of chemical structures that can pyrolyze to various inorganic silicon-based compounds under appropriate conditions. They analyzed stress-density correlations of alumina sediments as a function of two major variations in additive chemistry: (1) the attachment of polar (carbonyl) pendants to the siloxane backbone, and (2) changes in the molecular weight of nonpolar $[MeHSiO]_x$ (hydrosiloxane). 14 refs., 3 figs.

14935 (UCRL-JC–105376) **In-situ scanned probe studies on site specificity of laser surface damage of graphite, sapphire, and multilayer coatings.** Tench, R.J. (California Univ., Davis, CA (USA). Dept. of Applied Science); Schildbach, M.A.; Balooch, M.; Siekhaus, W.J.; Tesar, A. Lawrence Livermore National Lab., CA (USA). Jan 1991. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910186–1: Engineering Foundation conference, Santa Barbara, CA (USA), 1-11 Jan 1991). Order Number DE91008568. Source: OSTI; NTIS; GPO Dep.

The relationship between nm-scale surface structure and the laser- surface damage threshold is explored by exposing a sample mounted in a scanned probe microscope, and comparing the surface structure of a chosen area before and after exposure to a laser. On cleaved pyrolytic graphite, step edges damage first by exfoliation of atomic layers and recession of steps through removal of mono- or multi-layer patches. On sapphire, damage is not strongly correlated with polishing scratches, and consists of holes. These holes and the debris ejected and deposited do not predictably trigger damage by subsequent pulses. This indicates the surface structure is not likely to be the determining factor in the damage threshold of sapphire. Anti-reflective (AR) and highly-reflective (HR) coatings show predamage "annealing." 7 figs., 20 refs.

14936 **Titania extrudates.** Daamen, J.T.; Schaper, H.; Veen, J.A.R. Van. 23 Sep 1990. Filed date 21 Mar 1990. Canada Patent patent application 2012663. 13p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

It has been found that titania extrudates can be suitably prepared when use is made of an alkanolamine or ammonia or an ammonia-releasing compound in the preparation of a dough from which titania extrudates can be obtained. Accordingly, a process is disclosed for preparing titania extrudates which comprises mixing and kneading a particulate titania with water and with an alkanolamine or ammonia or an ammonia-releasing compound to obtain a mixture having a total solids content of 50-85 wt %. The alkanolamine or ammonia is present in an amount of 0.5-20 wt % of the total solids content of the mixture. The mixture is then extruded. A process is also provided for manufacturing calcined titania extrudates by calcining the extrudates obtained in the above process to a final temperature between 300 and 1000°C. The titania extrudates can be suitably used as carriers for catalysts which are normally used in hydroconversion processes, in hydrogenation processes, in hydrocarbon synthesis processes, or in the purification of exhaust gases. Experiments are described to illustrate the invention.

3606 Other Materials

Refer also to citation(s) 14040, 14241, 14244, 14258, 14418, 14434, 14502, 14671, 14787, 14836, 14839, 14843, 14847, 14935, 15037, 15827, 15952

14937 (ANL/CP–70841) **Diffusion in $YBa_2Cu_3O_{7-\delta}$.** Rothman, S.J.; Chen, Nan; Routbort, J.L. Argonne National Lab., IL (USA). Jan 1991. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-910212–3: High-temperature superconductors: processing and microstructure property relationships, New Orleans, LA (USA), 17-21 Feb 1991). Order Number DE91010268. Source: OSTI; NTIS; GPO Dep.

This paper presents a review of diffusion data in $YBa_2Cu_3O_{7-\delta}$ including tracer and chemical diffusion of oxygen and tracer diffusion Cu. New results on the diffusion of Ba, Y, and some rare earths, Dy, Ho, Gd are also presented. The activation energies are compared with those for sintering and creep. Some diffusion results deduced from the interaction between $YBa_2Cu_3O_{7-\delta}$ thin films and various substrates are discussed. 50 refs., 6 figs., 2 tabs.

14938 (CEA-CONF–10427) **Characterization of the R7T7 LWR reference glass.** Pacaud, F. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (FR)); Fillet, C.; Baudin, G.; Bastien-Thiry, H. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France). 1990. 13p. (CONF-9005332–: 2. International Seminar on Radioactive Waste Products, Juelich, DE (USA), 28 May - 1 jun 1990). Order Number DE91762823. Source: OSTI; NTIS (US Sales Only).

Characterization describes the glass properties by means of standard tests with no attempt to assess its long-term behavior. Characterization involved complementary comparative investigations of nonradioactive laboratory glass specimens, radioactive glass specimens prepared in laboratory hot cells, and nonradioactive industrial glass samples fabricated in the full-scale continuous

vitrification prototype facility (specimens were taken from the casting stream and core-samples were taken from a 200 kg glass block after cooling in the canister). Additional measurements are planned on actual radioactive glass samples fabricated in the R7 facility at La Hague. The results are indicated for each of the properties studied: physical, thermal and mechanical properties; structure and homogeneity examination; thermal stability and crystallization; resistance to chemical corrosion; irradiation resistance and volatilization. Comparative examination of glass samples of different origins showed consistent properties.

14939 (CEA-CONF–10439) **Physicochemical properties and long-term behavior of french R7T7 nuclear waste glass.** Vernaz, E. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France). 1990. 11p. (CONF-9010339–: 10. National Scientific Technical Conference with International Participation: Glass and Fine Ceramics, Varna (Bulgaria), 18-20 Oct 1990). Order Number DE91762822. Source: OSTI; NTIS (US Sales Only).

The French R7T7 nuclear glass composition was carefully selected to allow incorporation of some thirty different oxides found in fission product solutions. The resulting glass exhibits very low crystallization, and its physical and chemical properties are very similar to those of standard industrial glasses. Nuclear glasses have been shown to withstand α doses corresponding to several hundred thousand years under repository conditions. Predicting the long-term behavior of fission product glasses subjected to aqueous corrosion is no doubt the most difficult aspect of the problem. Predictions are necessarily based on mathematical models. A substantial research effort has been undertaken to identify all the basic corrosion mechanisms liable to control long-term alteration. These mechanisms are now relatively well understood, and provide the basis for developing the indispensable models. Realistic storage conditions exist under which glass alteration occurs at a very slow rate, and can fulfill its role as the first containment barrier for several tens of thousands of years.

14940 (CEA-CONF–10440) **R7T7 nuclear waste glass behavior in moist clay: role of the clay mass/glass surface area ratio.** Godon, N.; Vernaz, E. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France). 1989. 8p. (CONF-891129–: Scientific basis for nuclear waste management, Boston, MA (USA), 27 Nov - 2 dec 1989). Order Number DE91762827. Source: OSTI; NTIS (US Sales Only).

R7T7 glass alteration was investigated in the presence of various moist clays. In contact with smectite 4a, selected in France as a potential engineered barrier material, the glass was significantly corroded: after 6 months the glass corrosion rate was practically the same as the initial alteration rate in double-distilled water. Substantially lower alteration was observed in contact with bentonite 6 activated by sodium carbonate. Smectite 4a consumes silicon released by glass corrosion, and thus retards the rise to high silicon concentrations in solution at which the glass corrosion rate diminishes. Glass can therefore in some cases be altered as much in moist clay as in water with high renewal rates. Other experiments with smaller quantities of smectite 4a showed that the phenomenon becomes less important in time: its duration is proportional to the ratio between the clay mass (C) and the glass surface area (SA). Comparing the results of studies at different C/SA ratios indicates that low glass corrosion rates are obtained more slowly at higher C/SA ratios. Tests with ^{239}Pu-doped R7T7 glass also showed that the radionuclide retention factor in the alteration film at the glass surface is only 6, compared with a factor of nearly 50 in double-distilled water.

14941 (CEA-CONF–10441) **Thermokinetic model of borosilicate glass dissolution: contextual affinity.** Advocat, T. (CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (FR)); Vernaz, E.; Crovisier, J.L.; Fritz, B. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France). 1989. 8p. (CONF-891129–: Scientific basis for nuclear waste management, Boston, MA (USA), 27 Nov - 2 dec 1989). Order Number DE91762828. Source: OSTI; NTIS (US Sales Only).

Short and long-term geochemical interactions of R7T7 nuclear glass with water at 100°C were simulated with the DISSOL thermokinetic computer code. Both the dissolved glass quantity and the resulting water composition, saturation states and mineral quantities produced were calculated as a function of time. The rate equation used in the simulation was first proposed by Aagaard and Helgeson. It simulates a gradually diminishing dissolution rate as the reaction affinity diminishes. The best agreement with 1-year experimental data was obtained with a reaction affinity calculated from silica activity (Grambow's hypothesis) rather than taking into account the activity of all the glass components as proposed by Jantzen and Plodinec. The concept of residual affinity was introduced by Grambow to express the fact that the glass dissolution rate does not cease. We prefer to replace the term residual affinity by contextual affinity, which expresses the influence on the dissolution rate of three factors: the solution chemistry, the metastability of SiO_2(m), and the possible precipitation of certain aluminosilicates such as zeolites. 19 refs.

14942 (CEA-CONF–10444) **Effects of the SA/V ratio on the long-term corrosion kinetics of R7-T7 glass.** Vernaz, E.; Advocat, T.; Dussossoy, J.L. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France). 1989. 11p. Contract FI 1W-0030. (CONF-890488–: 4. international symposium on ceramics in nuclear waste management, Indianapolis, IN (USA), 23-27 Apr 1989). Order Number DE91762826. Source: OSTI; NTIS (US Sales Only).

A glass silica solubility limit near the value reported by Grambow was observed for R7-T7 glass. A constant residual corrosion rate was not observed, however. The final rate cannot be considered as a characteristic glass property which can be used in long-term behavior models. As the final rate dropped to less than (10^{-4} $g{\cdot}m^{-2}d^{-1}$) for the higher SA/V ratios, it may be assumed that there is no glass residual affinity. The very low corrosion rates detected in distilled or crystalline water are not directly applicable to complex storage situations where environmental materials, notably clay particles, can prevent saturating conditions from being obtained.

14943 (CONF-9106131–1) **Interlaminar strains at the free-edge of a hole for thick composites in compression.** Boeman, R.G. Oak Ridge National Lab., TN (USA). [1991]. 16p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract AC05-84OR21400. Grant N00014-90-J1688;Grant N0014-86-K0799;Contract TZ-689900-0A From 1991 Society for Experimental Mechanics spring conference; Milwaukee, WI (USA); 9-13 Jun 1991. Order Number DE91008883. Source: OSTI; NTIS; GPO Dep.

The experimental technique of moire interferometry was extended to take measurements of in-plane deformations on the cylindrical surface of a hole in thick laminated composites. A replication scheme was developed to produce high-frequency diffraction gratings on singly-curved surfaces. Techniques were developed to interrogate specimen gratings on 25.4 mm (1 in.) diameter holes in order to study free-edge effects on the hole surface. Interlaminar deformations were measured on a ply-by-ply basis for the first time on the cylindrical surface of a hole. Results are presented for a graphite/epoxy composite laminate with a $[90_2/0_4]P_{4s}$ stacking sequence. Interlaminar normal and shear strains were determined and plotted versus the ply number at angular locations of 0°, 45° and 90° with respect to the loading axis. Strong variations of strains with angular position were revealed. Interlaminar shear strains along a 0°/90° interface were measured and plotted as a function of the angular position. The shape of the curve compares favorably with analytical results found in the literature for a similar geometry. 18 refs., 8 figs.

14944 (ECN-C–90-053) **Ceramic membranes for high temperature gas separation.** Van Veen, H.M.; Terpstra, R.A.; Tol, J.P.B.M.; Veringa, H.J. Netherlands Energy Research Foundation, Petten (Netherlands). Nov 1990. 39p. (In Dutch). Project STW BCH58.0851;Project PCM PCM-87-136-I. Order Number DE91760576. Source: OSTI; NTIS (US Sales Only).

The aim of the project is to develop ceramic (alumina) membranes for high temperature (500 C) gas separation. The membrane surface has semi-industrial dimensions. The research aims specifically at material development of multilayered ceramic membrane systems, modification and pore size reduction of the top layer, Knudsen diffusion at high temperatures, separation processes by stimulated specific adsorption of gas molecules on the membrane surface, and separation by capillary condensation. From the results it is concluded that the above-mentioned membranes can be useful in applications where polymer membranes are no

longer competitive, like dehydrogenation reactions. 8 figs., 24 refs., 3 tabs., 2 apps.

14945 (ECN-C–90-061) **Forming high-Tc superconductors.** Rabou, L.P.L.M.; Roskam, A.; Smit, H.C.D.; Veringa, H.J. Netherlands Energy Research Foundation, Petten (Netherlands). Dec 1990. 43p. (In Dutch). Order Number DE91760568. Source: OSTI; NTIS (US Sales Only).

Within the framework of the National Research Program High-Tc Superconductors the Netherlands Energy Research Foundation carried out research on the title subject by means of ceramic techniques. The aim is to manufacture bulk superconductors formed as a wire, plate or as a pipe. First the preparation of $YBa_2Cu_3O_7$ related compounds and BiCaSrCuO by means of citrate pyrolysis and some other preparation methods are discussed. Also an overview is given of the mechanical and temperature treatment, and the analyses of the powders. Then attention is paid to the ceramic forming techniques of $YBa_2Cu_3O_7$: pressing (uniaxial, cold isostatic), tape casting, extrusion, slip casting and plasma spraying. 16 figs., 6 refs., 10 tabs.

14946 (ECN-RX–90-074) **C-Axis projected electron-positron momentum density in $YBa_2Cu_3O_7$.** Bansil, A. (Northeastern Univ., Boston, MA (USA)); Mijnarends, P.E.; Smedskjaer, L.C. Netherlands Energy Research Foundation, Petten (Netherlands). Oct 1990. 18p. Order Number DE91760543. Source: OSTI; NTIS (US Sales Only).

The theoretical c-axis projected electron-positron momentum density $N_{2\gamma}(p_x,p_y)$ in $YBa_2Cu_3O_7$ is presented based on the local density approximation (LDA) framework along various lines in momentum space. The calculations use the Korringa-Kohn-Rostoker (KKR) band structure formalism. The anisotropic distribution defined by taking cuts through the calculated spectra along different lines in the (p_x,p_y) plane possesses complex structures which arise from both Fermi surface effects and the anisotropy of the smoothly varying underlying background from filled bands; the maximum size of the anisotropy is about 10% of $N_{2\gamma}(0,0)$. The theoretically predicted $N_{2\gamma}(p_x,p_y)$ distribution is compared with the measured 2D-ACAR spectrum. It is suggested that in interpreting the 2D-ACAR data on $YBa_2Cu_3O_7$ in terms of a band theory LDA picture, a substantial, largely isotropic, background should be subtracted from both the 2D-ACARs and the associated LCW-folded spectra. 7 figs., 13 refs.

14947 (FRCEA-TH–308) **Study and characterization of III-V semiconductor materials for applications in ionizing radiation detection.** Moulin, H. CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. d'Electronique et de Technologie de l'Informatique; Grenoble-1 Univ., 38 (France). Nov 1989. 288p. (In French). Order Number DE91767829. Source: OSTI; NTIS (US Sales Only).

The photoconduction in the bulk of the gallium arsenide (GaAs) and of the indium phosphide doped with iron (InP:Fe) is investigated. These semiconductor materials are to be applied in X rays detection. The photoconduction theory and the physical characteristics of those materials are reviewed. The computer simulation models for studying the photoconductor responses to the radiation pulses are described. The experimental results are discussed. They include the following aspects: the characterization of the GaAs and InP:Fe, in the obscurity, as a function of the polarized electric field and of the neutrons dose; the characterization under X ray. Continuous X rays and pulsed synchrotron radiation are applied.

14948 (IC–90/298) **The pull-out energy of composites with fractal structure.** Lung, C.W. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 16p. Order Number DE91625673. Source: OSTI; NTIS (US Sales Only); INIS.

This paper analyses the pull-out energy of composites with fibers arranged as a fractal tree. it is found that this kind of structure may increase the pull-out energy and hence the fracture toughness of composites. (author). 4 refs, 3 figs, 2 tabs.

14949 (IS-T–1524) **Interface stability and defect formation during crystal growth.** Fabietti, L.M.R. Ames Lab., IA (USA). 8 Jan 1991. 220p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-82. Order Number DE91007520. Source: OSTI; NTIS; GPO Dep.

Thesis submitted to Iowa State University.

Unidirectional solidification experiments have been carried out in organic crystals with the aim of improving our knowledge on the effects of constraints on the interface morphology and to increase our understanding of the growth of anisotropic materials. The experimental information shows that lateral constraints such as a sharp change in the cross-sectional area in the solid liquid interface path, can produce important changes in the microstructure if the interface morphology is planar, cellular or dendritic. The study of anisotropic materials cover several topics. It is first shown that slight anisotropy does not influence the dendrite tip selection criterion. This conclusion is obtained from the analysis of the relationship between tip radius and velocity for dendrites growing under the steady state condition for two different materials, CBr_4 and C_2Cl_6, which have different surface energy anisotropy values. The values of the dendrite operating parameters σ^* are compared with the predictions of the solvability theory and the morphological stability theory. The experiments show better agreement with the latter theory. Critical experiments have been designed and carried out to find the response functions which determine the composition and temperature of the interface as a function of velocity in faceted materials. The experiments, carried out in Napthalene-Camphor system, indicate a strong temperature dependence of the planar interface growth which can be correlated with the step growth mechanism. Experiments on the interface instability show an important dependence on the crystallographic orientation. Unidirectional solidification experiments in zone refined Napthalene confined in very thin cells (gap size ≤ 50 μm) have proven to be a good method to study the defect production at the solid liquid interface. 118 refs., 90 figs., 5 tabs.

14950 (JAERI-M–90-216) **Evaluation of radiation-induced degradation of silicon 'O' ring.** Ikeshima, Yoshiaki (Japan Atomic Energy Research Inst., Oarai, Ibaraki (Japan). Oarai Research Establishment); Shiraishi; Tadao; Sato, Ryuichi; Tanaka, Isao; Ichihashi, Yoshinori; Ito, Masayuki. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1990. 48p. (In Japanese). Order Number DE91767906. Source: OSTI; NTIS (US Sales Only); INIS.

Currently there is too few available data on mechanical properties of an 'O' ring made of organic material, which is used over an extensive period of time under actual Nuclear Reactor environmental conditions. The 'O' rings which were evaluated were made of Silicon Rubber, and are used to provide water tightness. The 'O' rings also served as a pressure boundary within the nozzle of the in-reactor tube in the Water Loop-2 (OWL-2) at the JMTR in Oarai, Ibaraki. The 'O' rings were subjected to a constant penetrating radiation (up to 3.46 kGy) over a period of thirteen (13) years. The effects on the mechanical properties of a Silicon Rubber 'O' Ring were evaluated after having been used over an extensive period of time in an actual in-reactor tube within a radiation environment; a full thirteen years in durations. In making comparison of the properties of other Silicon Rubber 'O' Rings. It was also found that these other 'O' rings were subject to Gamma Rays for a shorter period, but with the same amount of radiation as the 'O' rings in the reactor were supposedly to have received. The evaluation showed that a Silicon Rubber 'O' Ring could have been used for a period, as much as forty (40) years even with a (absorbed) dose of about 300 kGy, before the life expectancy of such an 'O' ring is fully met. It was also discovered that the mechanical properties of an Ethylene Propylene 'O' Rings (currently used in the new OWL-2 in-reactor tube) were much superior to those of the Silicon Rubber 'O' Rings. The Ethylene Propylene 'O' Rings had a live expectancy which was about three times that of a Silicon Rubber 'O' Rings. (author).

14951 (KFK–4783) **Creep and oxidation behaviour of SiC-whisker-reinforced Al_2O_3/ZrO_2 composites.** Wang, P. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau. Sep 1990. 174p. (In German). Order Number DE91764470. Source: OSTI; NTIS (US Sales Only); INIS.

Oxidation tests in air at temperatures up to 1450deg C following two heating types and four-point-bending creep experiments under

bending stresses between 40-160 MPa at temperatures from 1000 up to 1350deg C in air or vacuum were performed with SiC-whisker reinforced Al_2O_3/ZrO_2 composites. The materials before and after oxidation and creep tests have been characterized with different methods. The measured results are explained and discussed with corresponding models and theories. (orig.).

14952 (LA-UR-91-1043) **Strain release in GaAs/$Ga_{1-x}In_xAs$ strained layer superlattices grown on (112) substrates.** Mitchell, T.E.; Unal, O. Los Alamos National Lab., NM (USA). [1991]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910322--1: 7. Oxford conference on microscopy of semiconducting materials, London (UK), 25-28 Mar 1991). Order Number DE91009972. Source: OSTI; NTIS; GPO Dep.

$GaAs/Ga_{1-x}In_xAs$ strained layer superlattices with well-widths of 7nm, barrier widths of 14nm and periods of 10 to 30 have been examined by TEM for (112) substrates. Individual layers are below the critical thickness while the overall SLS is above its critical thickness. Two sets of primary 79° dislocations are observed lying along $(\bar{1}\bar{3}2)$ directions, while for larger periods two additional sets of secondary 60° dislocations are observed lying along $[1\bar{1}0]$. This is discussed in terms of the resolved shear stresses resulting from coherency strains. 11 refs., 5 figs.

14953 (SAND-90-1018) **Shock characterization of epoxy: 42 volume percent glass microballoons.** Weirick, L.J. Sandia National Labs., Albuquerque, NM (USA). Feb 1991. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009616. Source: OSTI; NTIS; GPO Dep.

In the late 1960's, a series of shock experiments were done on ceramic-filled epoxies. The results from the shock characterization of these mixtures were compared to unfilled epoxy with $\rho_0 = 1.185$ g/cm^3. In that the volume percent fill was kept essentially constant, the shock Hugoniots formed a consistent family of curves relative to their initial densities. The present study examined the shock characteristics of an anhydride-cured epoxy (Epon 828 base) filled with approximately 42 volume percent glass microballoons (GMB) with a density of 0.94 g/cm^3. The Hugoniot relationship was determined between the shock pressures of 0.5 and 4.2 GPa. A light-gas gun was used to impact samples of the epoxy-GMB material onto targets of known impedance and known Hugoniot equation. A Velocity Interferometer System for Any Reflector (VISAR) laser interferometer system was used to measure the particle velocity in the known target material. From the measured projectile velocity and the Hugoniot of the known material, the particle velocity, shock velocity and pressure in the epoxy-GMB was determined. The Hugoniot relationship of the epoxy-GMB material is compared to those of the previous mixtures. A comparison of the epoxy-GMB material to a porous epoxy is also made. Shock attenuation studies were also done on this material. It was found that the shock wave profile consisted of an elastic and a plastic wave due to the initial strength of the glass microballoons, 0.24 GPa; the crushing of the glass microballoons, and the final state of dense epoxy, containing a small amount of glass. This material fits the P-α model very well. 12 refs., 15 figs., 6 tabs.

14954 (SAND-90-3049C) **Mechanical stress states in heterogeneous, wound rolls.** Reuter, R.C. Jr. Sandia National Labs., Albuquerque, NM (USA). [1991]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9105148--1: 1. international conference on web handling, Stillwater, OK (USA), 19-21 May 1991). Order Number DE91009257. Source: OSTI; NTIS; GPO Dep.

This paper presents a method of predicting the internal stress states in rolls wound with simultaneous supply spools of dissimilar material. The method is based on linear, orthotropic behavior of the mandrel and web materials, and is sufficiently general to allow completely arbitrary choices for the web materials and their respective winding tensions. The generality of the method also permits the introduction and termination of additional webs of arbitrary material at any time during the winding process. The method is analytical, and utilizes an elasticity solution with rigorous satisfaction of boundary conditions between each ply of the wound roll. A prototypical wound capacitor is used as an example to provide for numerical results of the internal stress states induced during the winding process. Differences in the winding tension loss of the two dissimilar web materials is discussed and explained, as are other mechanical threats to roll stability and performance. The influence of winding tension variations on internal, wound stress states is also discussed. 8 refs., 4 figs.

14955 (SAND-90-3129C) **Mechanical states in wound heterogeneous tapes by the finite element method.** Thomas, R.K. Sandia National Labs., Albuquerque, NM (USA). [1991]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9105148--2: 1. international conference on web handling, Stillwater, OK (USA), 19-21 May 1991). Order Number DE91009255. Source: OSTI; NTIS; GPO Dep.

The problem of predicting the mechanical stress and deformation states in wound tapes that result from the winding process is addressed by application of the finite element method. The generally heterogeneous tape construction is approximated by continuum finite elements each of which represents many tape plies. Material behavior within the finite element continuum is assumed to be orthotropic elastic. The actual winding process, in which stressed plies are added to an already stressed but partially wound tape, is simulated by sequentially activating layers of finite elements which have initial stress equal to the average winding stress. This model has been implemented in the three-dimensional code JAC3D. Numerical results are presented for the case of a regular two-dimensional circular geometry, for which analytical solutions have been reported in the literature. The favorable comparison between finite element results and analytical results for this example problem validate the finite element approach. 8 refs., 4 figs.

14956 (SAND-91-0586C) **Electronic properties of Si-doped n-doping-intrinsic-p-doping-intrinsic (nipi) structures in GaAs.** Fong, C.Y. (California Univ., Davis, CA (USA). Dept. of Physics); Gallup, R.F.; Nelson, J.S. Sandia National Labs., Albuquerque, NM (USA). [1990]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-901047--2: SPIE international conference on physical concepts of materials for novel optoelectronic devices applications, Aachen (Germany, F.R.), 27 Oct - 2 nov 1990). Order Number DE91009474. Source: OSTI; NTIS; GPO Dep.

The electronic properties of heavily and orderly Si-doped nipi structures in GaAs are studied theoretically using the ab-initio self-consistent pseudopotential method within the local density approximation. Two nipi configurations are considered. Besides investigating the nature of the impurity-related band edge states, the xy-planar-averaged local ionic and self-consistent potentials are also analyzed. The screening effect of the host crystal on the doping induced potential is found to be small. The effects of the doping induced electric field and the strain due to dopings are also examined. 13 refs., 9 figs., 2 tabs.

14957 (UCRL-JC-105106) **Investigation of neutral atom and ion emission during laser conditioning of multilayer HfO_2-SiO_2 coatings.** Schildbach, M.; Chase, L.L.; Hamza, A.V. Lawrence Berkeley Lab., CA (USA). [1990]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9010287--7: 22. Boulder damage symposium, Boulder, CO (USA), 25-26 Oct 1990). Order Number DE91009749. Source: OSTI; NTIS; GPO Dep.

It has been recently shown that the optical damage thresholds of multilayer coatings can be increased by up to a factor of two by conditioning the coating at laser fluences below the optical damage threshold. The authors have investigated the laser conditioning mechanism of HfO_2-SiO_2 coatings by observing the laser-induced emission of neutral constituents of the coatings during laser conditioning. They observe the ejection of Hf, Si and oxygen (O or O_2, or both) neutrals starting at fluences of about 10 J/cm^2, considerably below our measured unconditioned damaged threshold of about 16-18 J/cm^2. The authors observed a threshold pulse fluence for laser conditioning, which is also about 10 J/cm^2. This identical threshold for neutral emission and laser conditioning suggests that the neutral emission is caused by the laser conditioning

process. The emitted neutrals have extremely high kinetic energies, on the order of several tens of eV. On the basis of this information, they propose that the laser conditioning process is caused by microscopic damage that involves cracking of the coating layers, resulting in the ejection of the high-energy particles via a fractoemission process. This microscopic damage apparently raises the damage threshold by either reducing the absorption of coating defects or by relieving the thermal stresses that cause cracking, particle emission, and possible plasma formation by laser ionization of the neutrals. 5 refs., 8 figs.

14958 Method for preparing catalyst precursor for methanol synthesis. Nakamura, Tadasi; Tsuji, Kinya; Obata, Yoriko. 18 Sep 1990. Japan Patent priority 028774/1989;CA patent application 2006758. 23p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A method is provided for preparing a catalyst precursor for methanol synthesis using, as a copper source, copper sulfate recovered from copper etching waste solution. The method comprises using recovered copper sulfate containing the mother liquor in the amount of 10 wt % or less, and combining a zinc compound and an aluminum compound, if necessary, and a boron compound with the recovered copper sulfate. The mother liquor in the waste solution can be reduced to 10 wt % or less by known separation methods, preferably by centrifugation. The zinc source used in this invention can be zinc oxide, zinc sulfate, and zinc nitrate; the aluminum source can be alumina sol, aluminum sulfate, and aluminum nitrate; and the boron source can be boric acid and borax. A precipitant may, if necessary, be added to an aqueous metal salt solution of the above components. The precipitates of the metal carbonate salt obtained by the above procedure are then filtered and washed. The material is dried and then sintered, preferably at 300-450°C in an air atmosphere. Thereafter, a catalyst for practical use can be produced by conventional means such as molding. The composition of the catalyst prepared by this method is in the range of 0.2 to 12:1 in terms of the Cu/Zn atomic ratio. The catalysts prepared according to the method of this invention have characteristics equal to those prepared from expensive starting materials, and can be used in synthesis of methanol from gases comprising CO and H_2 and/or CO_2. Experiments are described to illustrate the method of the invention. 1 tab.

14959 Catalytic reactions using zeolite. Casci, J.L.; Lake, I.J.S.; Maberly, T.R. 31 Jul 1990. Filed date 22 Dec 1989. Canada Patent patent application 2006542. 60p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A novel zeolite called NU-87 is disclosed, as well as a method for making it and to processes using it as a catalyst. The NU-87 catalyst has a chemical composition expressed on an anhydrous basis, in terms of the mole ratios of oxides, by the formula $100XO_2:\leq 10Q_2O_3:\leq 20\ R_{2/n}O$, where R is one or more cations of valency n, X is silicon and/or germanium, and Q is one or more of Al, Fe, Ga, B, Ti, V, Zr, Mo, As, Sb, Cr, and Mn. The zeolite has, in its as-prepared form, an X-ray diffraction pattern including the lines shown in this patent application. The zeolite may be present in the catalyst in its hydrogen form, produced by calcination and/or ion exchange. The zeolite is prepared by reacting an aqueous mixture comprising a source of at least one oxide XO_2, optionally a source of at least one oxide Q_2O_3, optionally a source of at least one oxide M_2O, and at least one nitrogen-containing organic cation or precursors thereof, in which X and Q are as defined above and M is an alkali metal cation and/or ammonium. The reaction temperature is preferably 120-200 °C. At the end of the reaction, the solid phase is collected in a filter and washed, and is then ready for such further steps as drying, dehydration, and ion exchange. Experiments are described to illustrate the preparation of catalysts according to the invention and to show how these catalysts perform in such hydrocarbon conversion operations as catalytic cracking, isomerization, alkylation, and dewatering of feedstock. 7 figs., 17 tabs.

14960 Oxide superconducting material, process for preparing the same and applications thereof. Torii, Yasuko; Okura, Kengo; Kotani, Toshihiro. 17 Jul 1990. Filed date 5 Dec 1989. Canada Patent patent application 2004576. 64p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A superconducting oxide material is disclosed, containing compound oxide(s) having a composition represented by the formula $[(Tl_{1-x}Bi_x)_{1-p}\alpha_p]_qSr_yCa_zCu_vO_w$. In this formula, α is at least one element selected from a group consisting of In, Sn, Sb, Pb, Y, and lanthanide elements, and x, y, z, p, q, v, and w are numbers each satisfying a respective range of $0\leq x\leq 1.0$, $0.5\leq y\leq 4.0$, $0.5\leq z\leq 4.5$, $0\leq p\leq 0.6$, $0.5\leq q\leq 3.0$, and $1.0\leq v\leq 5.5$. The superconducting oxide material according to the invention preferably contains a compound oxide whose x is a number satisfying the range of $0.1\leq x\leq 0.5$. Examples of preferred superconducting oxides are presented from the systems Tl-Bi-Sr-Ca-Cu and Tl-Bi-Pb-Sr-Ca-Cu. The superconducting materials of this invention exhibit and maintain high critical current densities even in strong magnetic fields. Critical temperatures of these materials are mostly in the range of 100-115°K. The invention also provides processes for producing the superconducting materials described, using such techniques as sintering, thin film forming, and single crystal growth. Experiments are described to illustrate the properties of superconducting materials of the invention, and some applications of these materials in magnets and wires are provided. 16 figs., 22 tabs.

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Refer also to citation(s) 13991, 14207, 14208, 14209, 14211, 14319, 14349, 14764, 15183, 15220, 15221, 15287, 15326, 15327, 15341, 15342, 15458, 15666

14961 (ANL/ACL--90/1) **Remote detection of chemical agents by infrared spectroscopy: Progress report for FY 1989.** Demirgian, J.C.; Spurgash, S.M. Argonne National Lab., IL (USA). Analytical Chemistry Lab. Feb 1990. 77p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. Order Number DE91008987. Source: OSTI; NTIS; GPO Dep.

The results presented in this report demonstrate that Fourier transform infrared spectroscopy (FTIR) has tremendous potential for remote detection of chemical agents and will play a significant role in treaty verification. This application is based on the ability to positively identify an agent using its IR fingerprint and quantify it using partial least square software. The objective of this first year's effort was to establish remote FTIR capabilities at Argonne National Laboratory (ANL) and to test it in the Lab and at remote locations. These tests determined the sensitivity of the current equipment and helped gain knowledge to design the next generation of hardware. The results obtained to date can be summarized in three areas: ambient background considerations, sensitivity, and comparison of conventional vs. remote FTIR. Ambient background consists of IR energy pulses, which are present even on a cloudless day. The pulses make data analysis more difficult to interpret because of the changing background. The sensitivity of existing equipment is at the concentration-pathlength level of 1 ppM-m. This value was determined using agent-related chemicals released in front of a brick wall. Quantitation under field and Lab conditions is usually within ±20%. The primary difference between remote and conventional FTIR is that absorption at high concentrations is more linear for conventional FTIR. This means the large body of analytical results developed for conventional FTIR can also be applied to remote detection and is directly applicable for treaty verification scenarios. 18 refs., 29 figs., 11 tabs.

14962 (CEA-CONF--10443) **Aspects of optical fibers and spectrometric sensors in chemical process and industrial environments.** Boisde, G.; Perez, J.J. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI). 1988. 8p. (CONF-8809521--: International Congress on Optical Science and Engineering, Hamburg, DE (USA), 19-24 Sep 1988). Order Number DE91762821. Source: OSTI; NTIS (US Sales Only).

For on-line control, the two alternatives of automatic sample transfer and in situ remote analysis are discussed. New concepts are emerging from the possibilities offered by optical fibers. Absorption in the visible, UV and IR, fluorescence and Raman spectrometric techniques are examined. The state of the art of optodes and devices in chemical process control are given, with some examples of applications in nuclear plants.

14963 (CONF-871016–4) **Synergistic extraction of trivalent actinides and lanthanides using HTTA and an aza-crown ether.** Ensor, D.D. (Tennessee Technological Univ., Cookeville, TN (USA). Dept. of Chemistry); Nicks, M.; Pruett, D.J. Oak Ridge National Lab., TN (USA). [1987]. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 5. symposium on separation science and technology for energy applications; Knoxville, TN (USA); 25-30 Oct 1987. Order Number DE91009620. Source: OSTI; NTIS; GPO Dep.

An aza-crown ether, 4,13-didecyl-1,7,10,16-tetraoxa-4,13-diazacyclooc-tadecane (K22DD) has been shown to have a synergistic effect on the extraction of trivalent lanthanides and actinides by thenoyltrifluoroacetone (HTTA). The extraction of Am(3), Cm(3), Eu(3), Ce(3), and Pm(3) from an aqueous acetate buffer system (pH = 4.8) into HTTA/K22DD/chloroform phase was studied at 25°C. Distribution coefficients were measured as a function of HTTA concentration, K22DD concentration, and pH user radiotracer techniques. The synergistic species was determined from these studies to be $M(TTA)_3 \cdot K22DD$. The results show that the presence of K22DD synergizes the extraction of each of the metals studied by factors of approximately $10^4 - 10^5$. Slightly larger organic phase stability constants were measured for the trivalent actinides relative to the trivalent lanthanides. 15 refs., 2 figs., 2 tabs.

14964 (DOE/ER/13678–40) **A study of micellar-enhanced ultrafiltration: Progress report, March 1, 1990–April 30, 1991.** Scamehorn, J.F.; Christian, S.D. Oklahoma Univ., Norman, OK (USA). Feb 1991. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-87ER13678. Order Number DE91009521. Source: OSTI; NTIS; GPO Dep.

Research on ultrafiltration continued. Progress is briefly reported in four basic categories: systematic studies of the phenomenon of solubilization of organics in micelles and the mechanism of removal of organics from aqueous streams, using micellar-enhanced ultrafiltration (MEUF); systematic studies and the development of theoretical models for the binding of ions by micelles and polyelectrolytes; development and demonstration of four new related separation processes for removing ions from water: ligand-modified micellar-enhanced ultrafiltration (LM-MEUF), polyelectrolyte-enhanced ultrafiltration (PEUF), ion-explusion ultrafiltration (IEUF), and a combined surfactant-polyelectrolyte ultrafiltration process; and investigation of downstream processing of the effluent streams from all five of the UF separation processes.

14965 (ECN-C–90-043) **Statistical evaluation of an interlaboratory comparison for the determination of uranium by potentiometric titration.** Ketema, D.J.; Harry, R.J.S.; Zijp, W.L. Netherlands Energy Research Foundation, Petten (Netherlands). Sep 1990. 48p. Project nr. 0979;Contract CBNM/ST/85-70. Order Number DE91625520. Source: OSTI; NTIS (US Sales Only); INIS.

Upon request of the ESARDA working group 'Low enriched uranium conversion - and fuel fabrication plants' an interlaboratory comparison was organized, to assess the precision and accuracy concerning the determination of uranium by the potentiometric titration method. This report presents the results of a statistical evaluation on the data of the first phase of this exercise. (author). 9 refs.; 5 figs.; 24 tabs.

14966 (ETDE-mf–1764636) **Metal speciation in biological samples with the aid of atomic absorption spectroscopy.** Neidhart, B.; Blaszkewicz, M.; Dungs, K. Dortmund Univ. (Germany, F.R.). Inst. fuer Arbeitsphysiologie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Sep 1987 115p. (In German). Contract BMFT 0704830. Order Number DE91764636. Source: OSTI; NTIS (US Sales Only).

Metal speciation in biological samples with the aid of atomic absorption spectroscopy has proved a basically feasible, new analytic-chemical technique. However, it requires further development, involves complex apparatus, and is therefore not likely to be used for the time being in environmental analytics and industrial medicine except in special cases investigated efficiently and systematically. Particularly critical, as far as the redox pair Cr(III)/Cr(VI) is concerned, is the sampling steps: It involves the risk of the ratio of Cr(III) to Cr(VI) changing either during sampling itself or during subsequent preservation and storage of the sample until analysis. This holds good without restriction of all sample matrices. As a positive result to be mentioned is the following: Contrary to what is claimed by many authors, it is not possible at the moment to determine the total lead content of a sample by GFAAS without external mineralization if the sample contains both inorganically and organically bound lead. However, the reservation can be made that the share of organic lead in most biological matrices is slight and is within the error margin of lead(II) determination. (orig./EF).

14967 (IS-T–1528) **Advances in sample introduction for inductively coupled plasma spectrometry.** Wiederin, D.R. Ames Lab., IA (USA). 12 Mar 1991. 130p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-82. Order Number DE91009868. Source: OSTI; NTIS; GPO Dep.

Thesis submitted to Iowa State University.

The first section of this thesis describes a multi-step cryogenic method for desolvating the aerosol produced by an ultrasonic nebulizer when volatile organic solvents such as methanol and acetonitrile are nebulized. These solvents have been characterized in the literature as being "very difficult or impossible" to analyze by ICP spectrometry (72,73). With cryogenic desolvation, the solvent is removed to an extent that samples containing volatile organic solvents are no more difficult to analyze than aqueous samples. A nebulizer which sprays aerosol directly into the base of the plasma for ICP mass spectrometry is investigated in the second section. This nebulizer is a modification of the direct injection nebulizer (DIN) used previously for ICP emission spectrometry (74-76). A pulseless gas displacement pump for use with the DIN is also described. The DIN does not require a spray chamber, thus, it provides 100 % analyte transport efficiency as well as substantial improvements in absolute powers of detection and precision. Use of the DIN also reduced memory effects and is particularly convenient when sample volume is limited. The third section describes aerosol particle size measurements from the DIN. These data provide quantitative evidence that the DIN produces an aerosol with a narrower particle size distribution than other concentric nebulizer designs. The final section describes a method for performing on-line standard additions analyses for ICP mass spectrometry by using the DIN. The power of the method of standard additions for matrix effect correction can be applied to smaller samples at greater speeds than was previously possible. 176 refs., 20 figs., 10 tabs.

14968 (KCP–613-4184) **Multivariate calibration techniques applied to NIRA [near infrared reflectance analysis] and FTIR [Fourier transform infrared] data: Final report.** Long, C.L. Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div. Feb 1991. 46p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00613. Order Number DE91008159. Source: OSTI; NTIS; GPO Dep.

Multivariate calibration techniques can reduce the time required for routine testing and can provide new methods of analysis. Multivariate calibration is commonly used with near infrared reflectance analysis (NIRA) and Fourier transform infrared (FTIR) spectroscopy. Two feasibility studies were performed to determine the capability of NIRA, using multivariate calibration techniques, to perform analyses on the types of samples that are routinely analyzed at this laboratory. The first study performed included a variety of samples and indicated that NIRA would be well-suited to perform analyses on selected materials properties such as water content and hydroxyl number on polyol samples, epoxy content on epoxy resins, water content of desiccants, and the amine values of various amine cure agents. A second study was performed to assess the capability of NIRA to perform quantitative analysis of hydroxyl numbers and water contents of hydroxyl-containing materials. Hydroxyl number and water content were selected for determination because these tests are frequently run on polyol materials and the hydroxyl number determination is time consuming. This study

pointed out the necessity of obtaining calibration standards identical to the samples being analyzed for each type of polyol or other material being analyzed. Multivariate calibration techniques are frequently used with FTIR data to determine the composition of a large variety of complex mixtures. A literature search indicated many applications of multivariate calibration to FTIR data. Areas identified where quantitation by FTIR would provide a new capability are quantitation of components in epoxy and silicone resins, polychlorinated biphenyls (PCBs) in oils, and additives to polymers. 19 refs., 15 figs., 6 tabs.

14969 (SKB-TR–90-28) **Complex forming properties of natural organic acids. Pt. 2: Complexes with iron and calcium.** Ephraim, J.H. (Linkoeping Univ. (Sweden). Dept. of Water in Environment and Society); Mathuthu, A.S.; Marinsky, J.A. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Jul 1990. 26p. Order Number DE91625521. Source: OSTI; NTIS (US Sales Only); INIS.

An ultrafiltration technique combined with ion-selective-electrode and atomic absorption methods have been employed to obtain information on the complex forming properties of fulvic acid with iron and calcium. A model for interpreting complexation of metal ions to fulvic acid at any pH, medium ionic strength and metal to fulvic acid ratio developed earlier has been used in an attempt to predict the nature of iron and calcium interaction to Armadale Horizon Bh fulvic acid. Binding of calcium to fulvic acid which is enhanced at pHs greater than 6.0 has reasonably been predicted by the model taking into consideration complications due to the polyelectrolyte nature and the heterogeneity of the fulvic acid. The lack of agreement observed between the model predicted binding behavior and the experimentally observed results for the fulvic acid-iron system has been attributed to the formation of metal-induced aggregation. Reduction of Fe(III) to Fe(II) by the fulvic acid as reported by other workers is corroborated. (orig.).

4002 Inorganic, Organic, and Physical Chemistry

Refer also to citation(s) 13964, 14314, 14414, 14776, 14777, 14778, 14969, 14989, 14990, 15287, 15432

14970 (ANL/PP–67244) **Analytic solution of the Stochastic-Liouville model of spin-exchange.** Bartels, D.M.; Lawler, R.G. Argonne National Lab., IL (USA). [1991]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. Order Number DE91010570. Source: OSTI; NTIS; GPO Dep.

The solution of the stochastic Liouville model for spin exchange presented in the title article has been incorrectly applied to a measurement of exchange between $\cdot CH_2COO^-$ radicals. It is unnecessary to postulate a long-range exchange mechanism in this case. 12 refs.

14971 (DOE/ER/13442–5) **Energy transfer properties and mechanisms: Technical progress report.** Michigan Univ., Ann Arbor, MI (USA). 1991. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-85ER13442. Order Number DE91010266. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the energy transfer mechanisms in azulene, benzene, toluene, and isotopomers. Also discussed is the coupled energy reservoirs model, quantum effects in energy transfer, NO_2 energy transfer, densities of states, the reactant states model, and O_3 excited electronic states. (LSP)

14972 (DOE/ER/13451–5) **[Lewis acid modified molybdenum sulfide complexes]: Progress report.** Colorado Univ., Boulder, CO (USA). Dept. of Chemistry and Biochemistry. [1991]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-85ER13451. Order Number DE91009628. Source: OSTI; NTIS; GPO Dep.

Research continued on molybdenum sulfides. The kinetics and mechanism of the reaction of alkylthiolate cations and hydrogen have been studied in detail. Rates of the reactions have been monitored by visible spectroscopy. The reactions have been found to be first order in cation and first order in hydrogen. Pseudo first order rate constants for each cation, obtained in the presence of excess hydrogen, are given as is the dependence of k_{obs} on H_2 pressure. An appropriate plot of these data have led to the determination of the following activation parameters: $\Delta H^{\pm}$ = 84.8 KJ/mole, and $\Delta S^{\pm}$ = −52.18 J/mole-K. The kinetic data are consistent with the direct reaction of the cation with H_2 and have led to the proposal of an intermediate represented by a protonated form of the product, Structure A or B. 5 refs., 2 figs., 1 tab.

14973 (DOE/ER/13500–T2) **Spectroscopy, reaction, and photodissociation of highly vibrationally excited molecules: Progress report, November 1989–October 1990.** Crim, F.F. Wisconsin Univ., Madison, WI (USA). [1990]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-86ER13500. Order Number DE91008840. Source: OSTI; NTIS; INIS; GPO Dep.

This research is designed to determine the nature of highly vibrationally excited molecules, probe unimolecular reactions at the level of individual quantum states, and study the dynamics of electronic photodissociation from highly vibrationally excited states. In our experiments, pulsed laser excitation of a vibrational overtone transition prepares a highly vibrationally excited molecule and time-resolved spectroscopic detection of products monitors their subsequent decomposition. We have used this scheme to follow unimolecular reactions of large and small molecules in both room temperature gases and supersonic expansions and to investigate the role that vibrational excitation plays in electronic photodissociation dynamics. Most recently we have used the localized nature of the highly vibrationally excited states we create to selectively break bonds in photodissociation and biomolecular reactions.

14974 (DOE/ER/13965–3) **Double resonance reactant preparation for state-to-state studies of unimolecular reactions: Progress report, August 15, 1989–August 14, 1990.** Rizzo, T.R. Rochester Univ., NY (USA). Feb 1991. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-88ER13965. Order Number DE91010733. Source: OSTI; NTIS; INIS; GPO Dep.

These experiments use infrared-optical and optical-infrared double resonance spectroscopy to investigate the intramolecular dynamics of highly excited molecules. Application of the former approach to H_2O_2 and NH_2OH indicates that statistical rate theories must incorporate the partial conservation of K rotational motion into their calculations. This method has also resulted in accurate values of the lowest energy bond dissociation energy for these two molecules: 17,054 ± 5 cm^{-1} for H_2O_2 and 21,620 ± 20 cm^{-1} for NH_2OH. Moreover, these experiments reveal a barrier of 100–200 cm^{-1} for the recombination of two OH radicals on the lowest energy potential surface. Optical-infrared double resonance spectroscopy of high vibrational overtone levels allow us to measure the infrared spectrum of molecules at chemically significant energies. These spectra directly reveal the degree of localization of the wave functions prepared via vibrational overtone excitation. For molecules with sufficiently low density of states such as hydrogen peroxide, complete localization of 4 quanta of OH stretch excitation is possible. For molecules such as $HONO_2$ and t-butyl hydroperoxide excited to the $4\nu_{OH}$ level, energy redistribution occurs rapidly on a 10 ns timescale and extends over the whole molecule. 8 refs.

14975 (DOE/ER/13974–T1) **Theory and simulation of fluids of associated chain molecules: Progress report, March 1, 1990–February 28, 1991.** Cornell Univ., Ithaca, NY (USA). 9 Nov 1990. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-88ER13974. Order Number DE91009873. Source: OSTI; NTIS; GPO Dep.

During the past year we have continued our research on associating fluids and their mixtures, and have also initiated work on the behavior of fluids in small pores. We have successfully applied the new theoretical equation of state to a variety of pure liquids, including liquids of chain molecules up to decane, as well as a variety of associating liquids. Excellent results have been obtained for water, acetone, methanol, acetic acid, and nitric oxide. In parallel with this work we have been pursuing a program to make the theoretical equation more accurate and particularly to extend it to longer chains. We have begun a comprehensive study of the type of adsorption isotherms, layering and capillary transitions, and hysteresis effects that can be observed in Lennard-Jones fluids in pores of cylindrical and slit geometries, using a combination of density functional theory and molecular simulation techniques. 3 refs.

14976 (DOE/ER/60868–2) **Molecular modeling in the development of metal radiopharmaceuticals: Progress report, July 15, 1990–July 14, 1991.** Green, M.A. Purdue Research Foundation, Lafayette, IN (USA). Mar 1991. 34p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-89ER60868. Order Number DE91009345. Source: OSTI; NTIS; GPO Dep.

Research continued on the development of metal radiopharmaceuticals and the molecular modeling of metal complexes. We have completed a detailed comparison of four molecular mechanics computer programs to assess their applicability to modeling the structures of low molecular weight metal complexes. For this evaluation we tested the ability of each program to reproduce the crystallographic structures of 38 complexes between nickel(II) and saturated N-donor ligands. The programs were evaluated in terms of their ability to reproduce structural features such as bond lengths, bond angles, and torsion angles. BOYD and MM2DREW were found to best reproduce the structures of the nickel complexes, with SYBYL performing nearly as well. QUANTA was clearly poorer in structure reproduction. The susceptibility of the programs to falling into local energy minima was also investigated by using initial molecular coordinates that have been "randomized." BOYD and MM2DREW were found to easily fall into local energy minima, while SYBYL still reproduced structures well. Thus, it is concluded that SYBYL will be the most useful of these programs for reproducing the structures of metal complexes of saturated ligands.

14977 (IC–90/360) **Dielectric spectra of proteins in conducting media.** Ruderman, G. (International Centre for Theoretical Physics, Trieste (Italy)); Xammar Oro, J.R. de. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 14p. Order Number DE91625523. Source: OSTI; NTIS (US Sales Only); INIS.

Dielectric measurements of serum albumin and myoglobin in solutions of varying conductivities were performed. The results presented confirm that also for protein solutions, the Maxwell predictions of a threshold frequency in conducting materials holds. The threshold frequency of a serum albumin solution was experimentally determined. Attention should be recalled that, if the dielectric spectra of proteins solutions want to be measured, three distinct frequency regions are to be observed: a low frequency region, where the sample behaves like a conductor; an intermediate region centered around the threshold frequency, where the free charges partially screen the fixed ones; and a high frequency region where the sample behaves like a good dielectric. (author). 8 refs, 5 figs.

14978 (IC–90/368) **Threshold frequency for the ionic screening of electric fields inside electrolytic solutions.** Xammar Oro, J.R. de (La Plata Univ. Nacional, La Plata (Argentina). Inst. de Fisica de Liquidos y Sistemas Biologicos); Grigera, J.R.; Vericat, F.; Ruderman, G. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 16p. Order Number DE91625524. Source: OSTI; NTIS (US Sales Only); INIS.

The ionic screening of electric fields inside electrolytic solutions is studied. We report two methods for the direct evaluation of the Maxwell frequency for a series of aqueous solutions of electrolytes. Our results confirm that the expression for the Maxwell threshold frequency also holds for electrolyte solutions. Attention is drawn to the importance of considering the existence of a threshold frequency when dealing with charged macromolecules, enzyme reactions and any other problem when mobile charges interact in electrolyte solutions. (author). 8 refs, 7 figs.

14979 (IFP–38321) **Structural and textural characterization of dealuminated zeolites Y. Location of extra framework species by the Rietveld method.** Merlen, E. Institut Francais du Petrole (IFP), 92 - Rueil-Malmaison (France); Paris-6 Univ., 75 (France). Dec 1989. 245p. (In French). Order Number DE91762735. Source: OSTI; NTIS (US Sales Only).

Texture and structure of zeolite Y are characterised during conventional dealimination processing (hydrothermal treatment and acid attack). The techniques used include electron microscopy, photoelectron spectroscopy, NMR, infrared spectroscopy and a refinement structure technique on powder X-ray diffraction diagrams by the Rietveld method. Acidic sites are localized by the same method applied to neutron diffraction.

14980 (IMMR–89/201, pp. 287-292) **Microscopic characterization of emulsion interfaces.** Mikula, R.J. (CRL, Devon, Alberta (Canada)); Munoz, V.A.; Lam, W.W. Kentucky Univ., Lexington, KY (USA). Inst. for Mining and Minerals Research. [1989]. (CONF-891167–: 1989 Eastern oil shale symposium, Lexington, KY (USA), 15-17 Nov 1989). In *1989 Eastern oil shale symposium: Proceedings.* 548p. Source: OSTI; NTIS.

Certain process steps, in the extraction of oil from oil sands or during enhanced oil recovery, produce emulsions which must be broken in order to separate the oil. Microscopic characterization of these emulsions is therefore an important step in the prediction of processing characteristics and process yields. The size distribution of the process emulsion can determine how efficiently the oil can be separated from the water and by what means: mechanically or chemically. Optical and scanning electron microscopy coupled with automated image analysis have been applied to characterization of the size distribution of the dispersed phase in many of these emulsion systems. In addition, it is possible to characterize the nature of the dispersed phase by using fluorescence behavior in the optical system or via x-ray analysis with the scanning electron microscope. In certain cases it is possible to determine the chemical composition of the interface between the dispersed and continuous phases. Results from our laboratory illustrate the great potential of microscopic techniques, not only for studying the morphology of these economically important emulsions, but also for compositional determinations of the interface itself. Understanding these systems will lead to the development of improved methods of breaking these emulsions to increase production and reduce the cost of many petroleum extraction processes.

14981 (INIS-mf–12807, pp. 2.18-2.26) **Chemistry research for the Canadian nuclear fuel waste management program.** Vikis, A.C. (Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment); Garisto, F.; Lemire, R.J.; Paquette, J.; Sagert, N.H.; Saluja, P.P.S.; Sunder, S.; Taylor, P. Canadian Nuclear Society, Toronto, ON (Canada). 1988. 411p. (CONF-880943–: Uranium and electricity: the complete nuclear fuel cycle, Saskatoon (Canada), 18-21 Sep 1988). In *Proceedings of the international symposium on uranium and electricity: The complete nuclear fuel cycle.* Order Number DE91625698. Source: OSTI; NTIS (US Sales Only); INIS.

The overall objective of this research is to develop the fundamental understanding required to demonstrate the suitability of waste immobilization media and processes, and to develop the chemical information required to predict the long-term behaviour of radionuclides in the geosphere after the waste form and the various engineered barriers containing it have failed. Key studies include experimental and theoretical studies of uranium dioxide oxidation/dissolution; compilation of thermodynamic databases and an experimental program to determine unavailable thermodynamic data; studies of hydrothermal alteration of minerals and radionuclide interactions with such minerals; and a study examining actinide colloid formation, as well as sorption of actinides on groundwater colloids.

14982 (IS-T–1532) **Spontaneously adsorbed monolayer films: Fabrication, characterization, and application of monolayers of alkanethiol and sulfur-bearing cyclodestrin derivatives.** Chinkap, Chung. Ames Lab., IA (USA). 12 Mar 1991. 169p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-82. Order Number DE91009866. Source: OSTI; NTIS; GPO Dep.

Monolayers of n-alkanethiols ($CH_3(CH_2)_nSH$, n=1–17) and sulfur-bearing cyclodextrin derivatives spontaneously adsorbed on Ag and Au have been studied with a variety of surface characterization methods, such as infrared inflection spectroscopy, contact angle measurements, electro-chemistry, optical ellipsometry, and scanning tunneling microscopy. Long chain n-alkanethiols monolayers on Ag and Au are insulating to electron transfer and have contact angles indicative of well-ordered hydrocarbon terminated structures. Infrared and contact angle data indicate a different orientation of the methyl group with respect to the surface for chains with odd and even numbers of methylene groups. Compared to monolayers on Au, the alkanethiol monolayers on Ag are oriented more towards the surface normal. The observed odd-even effect

methyl group orientation for these monolayers on Ag is offset by a methylene group from that on Au. The relationships between the structure and packing of the monolayers on Ag and Au and the composition, roughness, and crystallinity of the substrate are also discussed. Monolayers of sulfur-bearing cyclodextrin derivatives on Au and Ag are fabricated by spontaneous adsorption and characterized by the above techniques. Size-selectively and molecular recognition of the α- and β- cyclodextrin cavity are shown with our monolayers. Because of molecular recognition, p-nitrophenol is retained preferrentially by the cyclodextrin monolayers over o-nitrophenol. 146 refs., 44 figs., 5 tabs.

14983 (LBL–29920) **Infrared spectroscopy of ionic clusters.** Price, J.M. (California Univ., Berkeley, CA (USA). Dept. of Chemistry). Lawrence Berkeley Lab., CA (USA). Nov 1990. 249p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91009732. Source: OSTI; NTIS; INIS; GPO Dep.

This thesis describes new experiments wherein the infrared vibrational predissociation spectra of a number of mass-selected ionic cluster systems have been obtained and analyzed in the 2600 to 4000 cm^{-1} region. The species studied include: the hydrated hydronium ions, H_3O^+ $(H_2O)_{3-10}$, ammoniated ammonium ions, $NH_4^+(NH_3)_{1-10}$ and cluster ions involving both water and ammonia around an ammonium ion core, (mixed clusters) $NH_4^+(NH_3)_n(H_2O)_m$ (n+m=4). In each case, the spectra reveal well resolved structures that can be assigned to transitions arising from the vibrational motions of both the ion core of the clusters and the surrounding neutral solvent molecules. 154 refs., 19 figs., 8 tabs.

14984 (PINSTECH/NPD–127) **Steady reactive state in an irreversible reaction.** Khan, G.; Khawaja, Y.; Sadiq, A. Pakistan Inst. of Nuclear Science and Technology, Islamabad (Pakistan). Nuclear Physics Div. Aug 1990. 18p. Order Number DE91624220. Source: OSTI; NTIS (US Sales Only); INIS.

6 fig.

A simple two component irreversible surface reaction model introduced by Ziff, Gulari and Bershad to study the reaction of carbon monoxide with oxygen has been investigated in detail by monte carlo simulation technique. The Model predicts a first order phase transition at a carbon monoxide feed concentration (Y=0.399) and a second order phase transition at (Y=0.5255). It is found that both the coverage of carbon monoxide and oxygen as well as the production of carbon dioxide with in the window described by the two critical points follows either a linear or an exponential behavior as a function of the concentration. The behavior of these quantities near the critical points is however more complicated. (author). 6 fig.

14985 (RISO-M–2851) **The behaviour of iodine in the terrestrial environment: An investigation of the possible enzymatically controlled iodination of humic acid.** Christiansen, J.V. Risoe National Lab., Roskilde (Denmark). Chemistry Dept. Feb 1990. 155p. Order Number DE91624221. Source: OSTI; NTIS (US Sales Only); INIS.

Literature on the geochemistry of iodine is surveyed, focusing on fundamental chemical aspects which influence the migration behaviour of iodine in the terrestrial environment. It is stated that the organic fraction in soil plays the predominant role in the retention of iodine. Simple aromatic molecules serve as simple models for humic acid, and humic acid is iodinated catalyzed by haloperoxidases. The enzymatically controlled iodination of humic acid is described in detail and it is demonstrated that the results may reflect a kind of equilibrium. It is shown that soil extracts are able to catalyze the iodination of humic acid and it is suggested that extracellular peroxidases in soil are reponsible for the reaction. The enzymatically controlled iodination of humic acid is discussed and some considerations about the influence on the migration of iodine in the terrestrial environment are given. (author) 4 tabs., 26 ills., 82 refs.

4004 Electrochemistry

Refer also to citation(s) 14668

14986 (LBL–29925) **Computer programs for simulation of electrodeposition.** Jordon, K.G. (California Univ., Berkeley, CA (USA). Dept. of Chemical Engineering); Tobias, C.W. Lawrence Berkeley Lab., CA (USA). Dec 1990. 359p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010203. Source: OSTI; NTIS; GPO Dep.

In this report, FORTRAN programs and subroutines useful for modelling moving boundaries in electrochemical systems are listed. These programs were used by Kenneth Guy Jordan to simulate moving boundaries during electrodeposition in presence of transport limited additives that acted wither by blocking the electrode to electrodeposition, or dissolving the electrode instantaneously upon their arrival, lowering the current efficiency. The programs were also used to analyze the behavior of evolving surface profiles during periodic current reversal.

14987 (PNL–7629) **Report on the source of the electrochemical impedance on cermet inert anodes: Inert Electrodes Program.** Windisch, C.F. Jr.; Stice, N.D. Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 36p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91008427. Source: OSTI; NTIS; GPO Dep.

the Inert Electrode Program at Pacific Northwest Laboratory (PNL) is supported by the Office of Industrial Processes of the US Department of Energy and is aimed at improving the energy efficiency of Hall-Heroult cells through the development of inert anodes. The inert anodes currently under study are composed of a cermet material of the general composition $NiO\text{-}NiFe_2O_4\text{-}Cu$. The program has three primary objectives: (a) to evaluate the anode material in a scaled-up, pilot cell facility, (b) to investigate the mechanisms of the electrochemical reactions at the anode surface, and (c) to develop sensors for monitoring anode and/or electrolyte conditions. This report covers the results of a portion of the studies on anode reaction mechanisms. The electrochemical impedances of cermet inert anodes in alumina-saturated molten cryolite as a function of frequency, current density, and time indicated that a significant component of the impedance is due to the gas bubbles produced at the anode during electrolysis. The data also showed a connection between surface structure and impedance that appears to be related to the effects of surface structure on bubble flow. Given the results of this work, it is doubtful that a resistive film contributes significantly to the electrochemical impedances on inert anodes. Properties previously assigned to such a film are more likely due to the bubbles and those factors that affect the properties and dynamics of the bubbles at the anode surface. 12 refs., 16 figs., 3 tabs.

4005 Photochemistry

Refer also to citation(s) 14973

14988 (CONF-8911293–) **11th lecture meeting of the Society of German Chemists, Photochemistry Group. Short version of lectures.** Gesellschaft Deutscher Chemiker, Frankfurt am Main (Germany, F.R.). Fachgruppe Photochemie. 1989 148p. (In German). From 11. meeting of the Fachgruppe Photochemie of Gesellschaft Deutscher Chemiker (GDCh); Duisburg (Germany, F.R.); 22-24 Nov 1989. Order Number DE91764467. Source: OSTI; NTIS (US Sales Only).

The lectures presented on the meeting deal with newer aspects of photo chemistry - like decomposition of organic compounds by means of oxidation, photosynthesis, photolysis, fluorescent solar collectors on the basis of protone transfer compounds, electron transfer processes in new sensitizers and relays. (DG).

14989 (DOE/ER/13263–7) **Oligomer and mixed-metal compounds: Potential multielectron transfer catalysts: Progress report, January 1, 1990–January 1, 1991.** Rillema, D.P. North Carolina Univ., Charlotte, NC (USA). Dept. of Chemistry. [1991]. 22p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-84ER13263. Order Number DE91009522. Source: OSTI; NTIS; GPO Dep.

Research continued on potential multi-electron transfer catalysts. A new ligand with an ethyl group bridging two 1,10-phenanthroline ligands was isolated. This ligand can be utilized for generating monometallic or bimetallic complexes. The copper(I) complex was prepared and illustrates the utility of the ligand. The copper(I) complex luminesced in fluid solution at room temperature. Several new

luminescing complexes of platinum(II) based on the biphenyl ligand were isolated. Their photophysical properties were separated into two classes, those emitting from ^{3}LC state and those emitting from a ^{3}MLCT state in the same compound. Temperature dependent emission lifetime studies of new ruthenium(II) complexes suggest that current explanations regarding the photophysics of these complexes may need to be reexamined. Barclay-Butler plots of the log of the preexponential factor vs ΔE, the Arrhenius activation energy, was linear for a wide range of ruthenium(II) complexes. Finally, progress continues to be made in understanding energy transfer processes in mixed metal ruthenium(II)/rhenium(I) ruthenium(II)/cobalt(III) complexes. Solvent plays a critical role in the luminescence from both the rhenium(I) and ruthenium(II) components in the bimetallic complex and this role was examined as a function of the heavy atom effect and other solvent properties. 34 refs., 2 figs.

14990 (DOE/ER/13492–T2) **Energy partitioning in elementary reactions: Progress report, November 1, 1989–October 31, 1990.** Bersohn, R. Columbia Univ., New York, NY (USA). Dept. of Chemistry. [1990]. 3p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-86ER13492. Order Number DE91007982. Source: OSTI; NTIS; GPO Dep.

In the past year three photodissociation projects were completed on acetylene, ethylene and the pair of molecules, cyclopentadiene and indene and an experiment begun on an interesting reaction of excited rare gas atoms and hydrogen molecules.

4006 Radiation Chemistry

Refer also to citation(s) 14263, 14288, 14950, 15397, 15783

14991 (IAEA-TECDOC–587) **Analytical detection methods for irradiated foods: A review of the current literature.** Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Mar 1991. 172p. Order Number DE91625550. Source: OSTI; NTIS (US Sales Only); INIS.

The present publication is a review of scientific literature on the analytical identification of foods treated with ionizing radiation and the quantitative determination of absorbed dose of radiation. Because of the extremely low level of chemical changes resulting from irradiation or because of the lack of specificity to irradiation of any chemical changes, a few methods of quantitative determination of absorbed dose have shown promise until now. On the other hand, the present review has identified several possible methods, which could be used, following further research and testing, for the identification of irradiated foods. An IAEA Co-ordinated Research Programme on Analytical Detection Methods for Irradiation Treatment of Food ('ADMIT'), established in 1990, is currently investigating many of the methods cited in the present document. Refs and tab.

14992 (SKB-TR–90-08) **Radiolytically induced oxidative dissolution of spent nuclear fuel.** Werme, L. (Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden)); Sellin, P.; Forsyth, R. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). May 1990. 17p. Order Number DE91624275. Source: OSTI; NTIS (US Sales Only); INIS.

A simple model for radiolytically controlled oxidation is proposed and numerical examples are given based on empirical data. The effects of solubility limits for some specific nuclides are also illustrated. (orig./HP).

14993 (SKB-TR–90-25) **Kinetics of UO_2(s) dissolution under reducing conditions: Numerical modelling.** Puigdomenech, I. (Studsvik Nuclear, Nykoeping (Sweden)); Casas, I.; Bruno, J. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). May 1990. 27p. Order Number DE91624276. Source: OSTI; NTIS (US Sales Only); INIS.

A numerical model is presented that describes the dissolution and precipitation of UO_2(s) under reducing conditions. For aqueous solutions with pH>4, main reaction is: $UO_2(s)+2H_2O \rightleftarrows U(OH)_4(aq)$. The rate constant for the precipitation reaction is found to be $\log(k_p)=-1.2\pm0.2$ h^{-1} m^{-2}, while the value for the rate constant of the dissolution reaction is $\log(k_d)=-9.0\pm0.2$ mol/(1 h m^2). Most of the experiments reported in the literature show a fast initial dissolution of a surface film of hexavalent uranium oxide. Making the assumption that the chemical composition of the surface coating is U_3O_7(s), we have derived a mechanism for this process, and its rate constants have been obtained. The influence of HCO_3^- and CO_3^{2-} on the mechanism of dissolution and precipitation of UO_2(s) is still unclear. From the solubility measurements reported, one may conclude that the identity of the aqueous complexes in solution is not well known. Therefore it is not possible to make a mechanistic interpretation of the kinetic data in carbonate medium. (orig.).

4007 Radiochemistry and Nuclear Chemistry

Refer also to citation(s) 14304, 14305, 15348

4008 Combustion, Pyrolysis, and High-Temperature Chemistry

Refer also to citation(s) 14043

14994 (DOE/ER/13508–5) **[Mass resolved resonance ionization spectroscopy of combustion radicals].** Cornell Univ., Ithaca, NY (USA). School of Applied and Engineering Physics. [1991]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-86ER13508. Order Number DE91010603. Source: OSTI; NTIS; INIS; GPO Dep.

Resonance-enhanced multiphoton ionization (REMPI) spectroscopy offers very low detection limits for nonperturbative, in situ, spatially resolved density measurements of combustion radicals. The REMPI approach is the only method currently available for ultrasensitive (sub part-per-million) monitoring of weakly fluorescing species. Even though REMPI spectroscopy has provided a remarkable body of new spectroscopic data on previously unobserved states of many molecules, the widespread application of REMPI for flame diagnostics is presently limited by the scarcity of spectroscopic data for Rydberg states of combustion radicals. The primary goal of this research is the discovery and characterization of such electronic states.

14995 (EUR–12772) **Kinetics and mechanisms of elementary chemical processes of importance in combustion: Final report, 1 April 1986–30 June 1989.** Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; UKAEA Harwell Lab. (UK). Engineering Science Div. 1990. 260p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract EN3E-0096(1)-UK(h). Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 21.25.

This report describe combustion research from the Commission of the European Communities. Activities have provided important new data on the reactions pertinent to the combustion of alkenes and aromatic hydrocarbons. This will help toward the development of detailed models for combustion of BTX fuels and PAH formation. Kinetic data on unsaturated radicals indicate that these radicals are unreactive with O_2 and hydrocarbons and emphasise the importance of radical- radical reactions in the combustion of alkenes and aromatics. Chemical analysis and optical measurements in sooting C_2H_4/air flames have provided information on the chemical structure of soot particles and the factors, such as temperature and C/O ratio, which influence soot growth and the H/C ratio of soot. The work has provided an insight into the mechanism for soot formation and clearly implicates the involvement of large aromatic molecules. A technique has also been devised for monitoring chemical change in fuel droplets in spray flames. Rate coefficients have been determined over a wide temperature range for several elementary reactions of the CN radical, providing reliable kinetic input data for modelling NO formation via the prompt-NO and fuel-nitrogen cycles. The temperature dependence of the rate coefficients and of the branching ratio for the OH-producing channel have been determined for the NH_2 + NO reaction which will be of great importance for modelling the Thermal DeNO_x process. Rate coefficients and branching ratios measured for the elementary steps in the CH_3/O_2 system together provide a complete kinetic description of this system over the temperature range 300–1600K within which there is an important change in mechanism for the CH_3 + O_2 reaction.

These data will considerably improve current models for CH_4 combustion and for ignition and quenching in hydrocarbon oxidation. 130 refs., 68 figs., 8 tabs.

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Refer also to citation(s) 14226, 14228, 14230, 14311, 14335, 14542, 14699, 14836, 15031, 15235, 15970, 15994, 16002

14996 (CEA-CONF–10438) **Maintenance of a high activity level reprocessing cell in the Marcoule pilot plant by mean of a Ma23 electronic telemanipulator.** Guay, P.; Roux, J.P.; Streiff, G.; Hancok, H. CEA Etablissement de la Vallee du Rhone, 30 - Bagnols-sur-Ceze (France). 1990. 5p. (CONF-900980–: ENS/ANS/FORATOM joint European Nuclear Congress and technology/industry exposition: looking into nuclear's future in the 21st century, Lyon (France), 23-28 Sep 1990). Order Number DE91762817. Source: OSTI; NTIS (US Sales Only).

The Marcoule Pilot Facility (APM) is used to test reprocessing methods and equipment under actual operating conditions with spent fuel at semi-industrial throughput rates and during demonstration runs of significant duration. In addition to the general objective of continuous long-term operation, the facility is also used for radioactive testing and qualification of specific process equipment items for planned or future reprocessing plants. This pilot function covers not only process operations but also other areas including remote manipulation. A remote manipulation system using an MA23 M electronic telemanipulator will be submitted to qualification testing in this way under actual operating conditions exposed to high irradiation levels together with numerous mechanical devices.

14997 (CONF-910188–1) **On kinematic design of serial link manipulators.** Paredis, C.J.J.; Khosla, P.K. Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Electrical and Computer Engineering. [1991]. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-89ER14042. From International symposium on intelligent robotics; Bangalore (India); Jan 1991. Order Number DE91009414. Source: OSTI; NTIS; GPO Dep.

The Reconfigurable Modular Manipulator System (RMMS) consists of modular links and joints which can be assembled into many manipulator configurations. This capability allows the RMMS to be rapidly reconfigured in order to custom tailor it to specific tasks. A important issue, related to the RMMS, is the determination of the optimal manipulator configuration for a specific task. In this paper, we address the problem of mapping kinematic task specifications into a kinematic manipulator configuration. For the design of 2 degrees-of-freedom planar manipulators, an analytical solution is derived. Since, for problems with more than 2 design parameters, analytical solutions become impractical, we have also developed a numerical approach for the design of 6 degrees-of-freedom manipulators. 29 refs., 7 figs.

14998 (CONF-910602–4) **Approximating the dynamic response of strain-hardening structures.** Youngdahl, C.K. Argonne National Lab., IL (USA). [1991]. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. From American Society of Mechanical Engineers (ASME) pressure vessels and piping conference; San Diego, CA (USA); 23-27 Jun 1991. Order Number DE91006392. Source: OSTI; NTIS; GPO Dep.

A mode approximation method is being developed to predict the dynamic plastic deformation of strain-hardening structures. A mode shape having time-dependent coefficients is based on quasi-static deformation profiles. Two stress fields are associated with the modal shape, one satisfying the dynamic relations and the other satisfying the constitutive equations. The application of suitable matching conditions results in a set of simultaneous differential and algebraic equations for the amplitude coefficients and plastic region size. Using the example of a simply supported beam, the effect of varying the number of matching conditions on the accuracy of the solution is presented. 5 refs., 7 figs.

14999 (CONF-910636–2) **Laboratory performance of a dynamic ice storage system.** Stovall, T.K.; Tomlinson, J.J. Oak Ridge National Lab., TN (USA). Jun 1991. 16p. Sponsored by Electric Power Research Inst., Palo Alto, CA (USA). DOE Contract AC05-84OR21400. From ASHRAE summer meeting; Indianapolis, IN (USA); 22-26 Jun 1991. Order Number DE91007282. Source: OSTI; NTIS; GPO Dep.

The performance of a commercial 30-ton dynamic ice storage system was measured in a dedicated laboratory test facility and the results analyzed. The ice storage system was tested over a wide range of operating conditions to characterize the ice generating performance as a function of condensing conditions, ice build time, and defrost time. The overall efficiency of ice production was determined and the effect of refrigeration system component performance on the overall system efficiency was evaluated. The ability of the charged system – a tank of ice slush – to meet a simulated cooling load over was also evaluated. 18 refs., 9 figs.

15000 (CONF-910638–2) **On the control of two manipulators holding a rigid object in the presence of uncertainty.** Dawson, D. (Clemson Univ., SC (USA). School of Electrical and Computer Engineering); Unseren, M.A. Oak Ridge National Lab., TN (USA); Clemson Univ., SC (USA). School of Electrical and Computer Engineering. [1991]. 23p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 1991 American control conference; Boston, MA (USA); 26 Jun 1991. Order Number DE90017742. Source: OSTI; NTIS; GPO Dep.

A dynamical model and a control architecture are developed for the closed chain motion of two six joint manipulators holding a rigid object in a three-dimensional workspace. Dynamic and kinematic constraints are determined and combined with the equations of motion of the manipulators to obtain a dynamical model of the entire system in the joint space. Reduced order dynamic equations are developed with regard to the position and force control variables. Control laws are then determined so as to decouple the force and position controlled degrees of freedom (DOF) during motion of the system. These control laws that will be discussed are a feedback linearization approach and then an adaptive motion controller in conjunction with a robust force controller. 22 refs., 2 figs.

15001 (EGG-M–90015) **Heat and mass transfer in the gas tungsten and gas metal arc welding processes.** Watkins, A.D; Smartt, H.B.; Einerson, C.J.; Watkins, J.A. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-9008199–1: 22. ICHMT international symposium on manufacturing and materials processing, Dubrovnik (Yugoslavia), Aug 1990). Order Number DE91010089. Source: OSTI; NTIS; GPO Dep.

The heat transferred from an electrode negative, argon gas tungsten arc to an anode was measured for a wide range of conditions suitable for mechanized welding. The results are given as (1) the arc efficiency and (2) the anode heat and current input distributions for various anode materials over a range of current and voltage. The nominal arc is Gaussian, ~4 mm in diameter, with ~75%heat transfer efficiency. Variations from these values are discussed in terms of the electrical and thermal energy transport mechanisms. Heat transferred to the workpiece (cathode) during direct current, electrode positive gas metal arc welding (GMAW) was measured for various parameters applicable to machine welding. The results are presented as a function of electrode speed for changing voltages and contact tip to workpiece distances. The total heat transfer efficiency was nominally 85% for a 0.89 mm diameter steel electrode using an argon-2% oxygen shielding gas; the nominal heat transfer efficiency of the droplet component was 40%. The average droplet temperatures ranged from 2400 to 3100 K, depending on the process parameters. A new method of measuring the heat transferred from the arc to the workpiece, using a boiling liquid nitrogen calorimeter, has been developed that gives rapid, accurate values. 20 refs., 8 figs., 2 tabs.

15002 (EGG-M–90397) **Approach for implementing burnup credit in high-capacity truck casks.** Boshoven, J.; Hopf, J.; Su, S. General Atomics, San Diego, CA (USA). [1991]. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-88ID12698. (CONF-910435–59: American Nuclear Society (ANS) international high level radioactive waste management conference,

Las Vegas, NV (USA), 28 Apr - 3 may 1991). Order Number DE91010094. Source: OSTI; NTIS; INIS; GPO Dep.

General Atomics (GA) will be submitting an application for certification to the US Nuclear Regulatory Commission (NRC) for the GA-4 and GA-9 Casks in 1992. To maintain a capacity of four pressurized-water-reactor (PWR) spent fuel assemblies, the GA-4 Cask uses burnup credit as part of the criticality control for the higher enrichments. Using the US Department of Energy (DOE) Burnup Credit Program as a basis, GA presents here an approach to burnup credit analysis to be included in the Safety Analysis Report for Packaging (SARP). 6 refs., 2 figs., 5 tabs.

15003 (EGG-M–90398) **Development of the GA-4 and GA-9 legal weight truck spent fuel shipping casks.** Meyer, R.J. General Atomics, San Diego, CA (USA). [1991]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-88ID12698. (CONF-910435–57: American Nuclear Society (ANS) international high level radioactive waste management conference, Las Vegas, NV (USA), 28 Apr - 3 may 1991). Order Number DE91010082. Source: OSTI; NTIS; INIS; GPO Dep.

General Atomics (GA) is developing two legal-weight-truck spent-fuel shipping casks for transporting commercial reactor spent fuel. The GA-4 pressurized-water-reactor (PWR) and the GA-9 boiling-water-reactor (BWR) casks are stainless steel with non-circular cross sections. Depleted uranium (DU) and boron polypropylene are used for gamma and neutron shielding. Solid pellets of boron carbide contained in a removable stainless steel fuel support structure provide criticality control. The GA-4 Cask utilizes burnup credit to maintain a capacity of four spent fuel assemblies for enrichments greater than 3.0 U-235 wt %. Aluminum honeycomb impact limiters and a dedicated semitrailer contribute to the overall efficiency and safety of the system. Design verification testing of a half-scale model cask will confirm the adequacy of the structural design.

15004 (EGG-M–90541) **GA-4/GA-9 honeycomb impact limiter tests and analytical model.** Koploy, M.A.; Taylor, C.S. General Atomics, San Diego, CA (USA). [1991]. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-88ID12698. (CONF-910435–58: American Nuclear Society (ANS) international high level radioactive waste management conference, Las Vegas, NV (USA), 28 Apr - 3 may 1991). Order Number DE91010095. Source: OSTI; NTIS; INIS; GPO Dep.

General Atomics (GA) has a test program underway to obtain data on the behavior of a honeycomb impact limiter. The program includes testing of small samples to obtain basic information, as well as testing of complete 1/4-scale impact limiters to obtain load-versus-deflection curves for different crush orientations. GA has used the test results to aid in the development of an analytical model to predict the impact limiter loads. The results also helped optimize the design of the impact limiters for the GA-4 and GA-9 Casks.

15005 (INIS-SU–231, pp. 105-107) **Studying the properties of radioactive products in gaseous effluents using the packetc of analytical filters and the PURGA-K cryogenic sampler.** Ogorodnikov, B.N.; Skitovich, B.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

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Method of studying composition of radioactive gaseous-aerosol effluents is suggested. This method is based on the fact of analytical filter made of filtering and sorption-filtering materials and is completely liquefied. Results of studying the capabilities of the considered sampling complex with differing in number and composition of analytical filters show high reliability of the suggected method. 3 refs.; 2 figs.

15006 (INIS-SU–231, pp. 116-118) **Specific features of radioactive aerosol trapping at high filtration rates.** Budyka, A.K.; Ogorodnikov, B.I.; Skitovich, V.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Using the fan model of fibrous filter the factors influencing radioactive aerosol trapping efficiency at filtration rates above 1 m/s, are studied. Formulae for calculation of the efficiency of any thickness filtering material depending on radioactive particles are obtained. With perticele size increase, V - decreases, as kinetic energy stronger depends on particle radius than on adhesion energy.

15007 (INIS-SU–231, pp. 121-124) **Recirculation ventilation systems.** Bitkolov, N.Z. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Analysis of recirculation ventilation of radioactive facility rooms is carried out. Use of recirculation system provides reduction of energy losses for thermalhumid air treatment due to decrease of the volume taken from the atmoshpere; decrease systems for air evacuation of purification systems functioning in a recirculation ring and possible increase of their airload; reduction of general impurity effluents into atmosphere.

15008 (JAERI-M–90-227) **On the non-trivial kinematic representations for six-link manipulators.** Sasaki, Shinobu (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1990. 18p. (In Japanese). Order Number DE91767924. Source: OSTI; NTIS (US Sales Only); INIS.

A solution technique of the inverse kinematics for multi-joint robot manipulators has been considered to be one of the most cumbersome treatment due to non-linearity properties inclusive of trigonometric functions. As one of the major causes, however, it might be responsible for the fact that we are oblivious to the weakness of approaches to deal with a set of equations given with vague considerations and/or occasionally by forces. The most important is to find out a class of truly non-trivial formulations among the kinematic equations from a viewpoint of lightening or avoiding a burden of computation as far as possible. Additionally, it is required to pay attention so as to reduce them to more simplified descriptions. In this paper, an analytical examination was made as to how to position and orientation of hand are influenced by the individual joint variables. As the result of it, a useful set of equations was presented to be contributive to derive the solutions with ease. This idea is favorably applicable to all types of six-link manipulators. (author).

15009 (ORNL/TM–11718) **Robot self-location in unknown environments.** Stuck, E.R. Oak Ridge National Lab., TN (USA). Feb 1991. 40p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. (CESAR–91/03). Order Number DE91010450. Source: OSTI; NTIS; GPO Dep.

It is often necessary for robots to navigate in environments which are not known in advance. In this context, self-location is the problem of determining how far and in what direction motion has occurred. Because of wheel slippage and other errors, odometry cannot be depended upon to provide precise or accurate positional information. Triangulating from visual features can help make position estimation more accurate. This paper describes work that was done during a three-month student research internship at the Center for Engineering Systems Advanced Research (CESAR) of the Oak Ridge National Laboratory, exploring the problem of robot self-location in unknown environments. This work included the development and integration of a set of programs which present a

partial solution to this self-location problem. These programs use a sequence of images which are acquired as the camera moves between positions with a motion which is known approximately. Visual features are extracted from the images and matched through time. Triangulation using these features then provides a rough estimate of the range of these features from the camera. Kalman filtering (not implemented) can then be used to integrate the information from odometry and vision to provide a better estimate of the position of the robot. 10 refs., 13 figs., 1 tab.

15010 (ORNL/TM–11733) **Performance of visual and ultrasound sensing by an autonomous robot.** Beckerman, M.; Barnett, D.L. Oak Ridge National Lab., TN (USA). Jan 1991. 34p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. (CESAR–90/54). Order Number DE91010452. Source: OSTI; NTIS; GPO Dep.

This paper presents results of an experimental study of the reliability of an autonomous mobile robot operating in an unstructured environment. Examined in the study are the principal components of the visual and ultrasound sensor systems used to guide navigation and manipulation tasks of the robot. Performance criteria are established with respect to the requirements of the integrated robotic system. Repeated measurements are done of the geometric and spatial quantities used for docking the robot at a mock-up control panel, and for locating control panel devices to be manipulated. The systematic and random components of the errors in the measured quantities are exhibited, their origins are identified, and means for their reduction are developed. We focus on refinements of visual area data using ultrasound range data, and on extraction of yaw by visual and by ultrasound methods. Monte Carlo methods are used to study the sensor fusion, and angle-dependence considerations are used to characterize the precision of the yaw measurements. Issues relating to sensor models and sensor fusion, viewed as essential strategic components of intelligent systems, are then discussed. 32 refs., 13 figs., 5 tabs.

15011 (SAND–90-2641C) **Production ready feature recognition based automatic group technology part coding.** Ames, A.L. Sandia National Labs., Albuquerque, NM (USA). [1990]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910689–1: ACM symposium on solid modeling foundations and CAD/CAM applications, Austin, TX (USA), 5-7 Jun 1991). Order Number DE91004789. Source: OSTI; NTIS; GPO Dep.

During the past four years, a feature recognition based expert system for automatically performing group technology part coding from solid model data has been under development. The system has become a production quality tool, capable of quickly the geometry based portions of a part code with no human intervention. It has been tested on over 200 solid models, half of which are models of production Sandia designs. Its performance rivals that of humans performing the same task, often surpassing them in speed and uniformity. The feature recognition capability developed for part coding is being extended to support other applications, such as manufacturability analysis, automatic decomposition (for finite element meshing and machining), and assembly planning. Initial surveys of these applications indicate that the current capability will provide a strong basis for other applications and that extensions toward more global geometric reasoning and tighter coupling with solid modeler functionality will be necessary.

15012 (SAND–90-3064C) **Contamination weeping: A chemical ion exchange model.** Chambers, W.B.; Doughty, D.H.; Jones, H.D.T.; Martinez, S.L.; Bennett, P.C. Sandia National Labs., Albuquerque, NM (USA). [1991]. 19p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (TTC–1037;CONF-910602–11: American Society of Mechanical Engineers (ASME) pressure vessels and piping conference, San Diego, CA (USA), 23-27 Jun 1991). Order Number DE91008175. Source: OSTI; NTIS; INIS; GPO Dep.

Experiments have been conducted to determine the applicability of a chemical ion-exchange model to characterize the problem of nuclear fuel transportation cask contamination and release ("weeping"). Surface charge characteristics of Cr_2O_3 and stainless steel (304) powders have been measured to determine the potential for ion exchange at metal oxide – aqueous interfaces. The solubility of pool contaminant Co and Cs electrolytes at varying pH and the adsorption characteristics of these ions on Cr_2O_3 and stainless steel powders in aqueous slurries have been studied. Experiments show that Co ions do reversibly adsorb on these powder surfaces and, more specifically, that adsorption occurs in the nominal pH range (pH = 4–6) of a boric acid-moderated spent fuel pool. Desorption has been demonstrated to occur at pH $\leq$ 3. Cs ions also have been shown to have an affinity for these surfaces although the reversibility of Cs^+ bonding by H^+ ion exchange has not been fully demonstrated. These results have significant implications for effective decontamination and coating processes used on nuclear fuel transportation casks. 9 refs., 5 figs., 1 tab.

15013 (SAND–90-3182) **Bobbin stresses generated by wire winding.** Metzinger, K.; Attaway, S.; Mello, F. Sandia National Labs., Albuquerque, NM (USA). [1991]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9105148–3: 1. international conference on web handling, Stillwater, OK (USA), 19-21 May 1991). Order Number DE91009545. Source: OSTI; NTIS; GPO Dep.

The prediction of bobbin stresses generated by wire winding is now possible by combining a finite element structural code and a rigid body motion code. In this combination of computer codes, the bobbin and the individual wire wraps are considered to be axisymmetric. Each wire wrap is modeled with a single one-node element that has stiffness, mass and radius. The distributed radial load that a wire wrap exerts on the bobbin or other wires is calculated by using a relationship developed for a thin ring with a circular cross section. In this analysis, a layer of wire wraps with a specified tension is applied to a bobbin. The bobbin contracts radially until an equilibrium position is reached. When a second layer is added, the bobbin and each wire in the first layer reach a new equilibrium position. The tensions and the distributed radial loads associated with each displaced wire in the first layer change accordingly. As additional layers are added, the tensions and the distributed radial loads for all the previously applied wires are adjusted to reflect their new positions. The stresses in the bobbin can be determined for any number of wire layers. Bobbin fixturing during winding can be simulated by imposing suitable boundary conditions on the bobbin's finite element mesh. A simple test problem is presented, providing a comparison between the finite element results and a closed-form solution. Quantitative results for bobbin stresses and wire tensions and then presented for more realistic coils. The impact of bobbin fixturing and wire packing structure on the stresses in the bobbin are also discussed. 3 refs.

15014 (SAND–91-0649C) **Direct optical phase shifter for phased-array systems.** Vawter, G.A.; Hietala, V.M.; Kravitz, S.H.; Meyer, W.J. Sandia National Labs., Albuquerque, NM (USA). [1991]. 5p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910450–3: SPIE international symposium on optical engineering and photonics in aerospace sensing, Orlando, FL (USA), 1-5 Apr 1991). Order Number DE91010480. Source: OSTI; NTIS; GPO Dep.

An all optical circuit in GaAs/AlGaAs for control of phased-array systems using a single photonic integrated circuit chip has the potential for high performance control of phased-array system from a small, lightweight, package. Such a circuit based exclusively on combinations of reverse-biased optical phase modulators, waveguide interconnects, corner reflectors, and power splitter combiners with optical-fiber output to the antenna elements has been designed at Sandia National Laboratories. This paper presents some basic features of optical phase modulators for photonic circuit applications and provide relevant performance data as achieved to data. Current structures have been shown to operate with a 76.5°/V-mm figure of merit at 1.06μm and losses as low as 2 cm^{-1}. A novel digital phase shifter to allow direct digital control of phased arrays is also proposed and demonstrated. 4 refs., 5 figs.

15015 (SAND–91-0650C) **Phased-array antenna control by a monolithic photonic integrated circuit.** Hietala, V.M.; Vawter, G.A.; Meyer, W.J.; Kravitz, S.H. Sandia National Labs., Albuquerque, NM (USA). [1991]. 7p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA).

DOE Contract AC04-76DP00789. (CONF-910450–4: SPIE international symposium on optical engineering and photonics in aerospace sensing, Orlando, FL (USA), 1-5 Apr 1991). Order Number DE91010479. Source: OSTI; NTIS; GPO Dep.

A novel optical based RF beam steering system is proposed for phased-array antenna systems. The system, COMPASS (Coherent Optical Monolithic Phased Array Steering System), is based on optical heterodyning employed to produce microwave phase shifting. At the heart of the system is a monolithic Photonic Integrated Circuit (PIC) constructed entirely of passive components. Microwave power and control signal distribution to the antenna is accomplished by optical fiber, thus separating the PIC and its control functions from the antenna. This approach promises to reduce size, weight, and complexity of future phased-array antenna systems. 5 refs., 4 figs.

15016 (UCRL-ID–106827) **Finite element analysis of the lateral buckling of a cantilevered I Beam.** Lovejoy, S.C. Lawrence Livermore National Lab., CA (USA). 30 Jan 1991. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91010123. Source: OSTI; NTIS; GPO Dep.

This report summarizes the investigation of modeling lateral buckling of a cantilever beam subjected to a uniform shear load on the free end using NIKE3D. First an analytic solution is presented using the Theory of Elastic Stability and Elastic Beam Theory. Four finite element models are then investigated and compared to the analytic solution. The four finite element models can be put into groups of two. The first group uses shell elements to model the beam. One model uses the Hughes/Liu shell formulation and the other uses the YASE shell formulation. The second group uses brick elements to model the beam with the first using the standard B-bar element formulation and the other using the B-bar with incompatible modes formulation. The Hughes/Liu model did not converge at any load but the remaining 3 models gave interesting and meaningful results that appear to be in good agreement with the analytic model.

15017 (WHC-SA–1009) **Buckling analysis of a complex vacuum vessel using the finite-element method.** Shurrab, M.S.; Ziada, H.H. Westinghouse Hanford Co., Richland, WA (USA). Jan 1991. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. (CONF-910602–20: ASME pressure vessels and piping conference, San Diego, CA (USA), 23-27 Jun 1991). Order Number DE91010032. Source: OSTI; NTIS; INIS; GPO Dep.

The vacuum vessel used for this study consists of four sections. These sections vary in thickness and geometry and are connected to each other by flanges. The vacuum vessel was modeled and analyzed using a commercially available finite-element code that has the capability to solve buckling problems by using axisymmetric-shell and 3-dimensional models. The buckling analysis was performed for the whole vacuum vessel. Buckling pressure for each model was calculated using the code. A technique was developed to analyze the resulting data and mode shapes to determine the buckling pressure for each individual section of the vacuum vessel. Results obtained from each model were similar and they compared favorably with results obtained from the closed-form solutions. The main advantage of the finite-element method is that it allows the buckling pressure for each individual section of a complex structure to be determined from the overall buckling analysis. 17 figs., 3 tabs.

15018 **Method and system for monitoring wall thickness of pipelines, pressure vessels etc. and a sensor to be used for the same purpose.** Standahl, O.; Solberg, P. 25 Sep 1990. Filed date 24 Jan 1990. Canada Patent patent application 2008520. 10p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A method is provided for monitoring the wall thickness of pipelines or vessels which is intended to be simpler and more accurate than prior methods, such as those using drilled holes or ultrasound. The monitoring is conducted via an electric circuit through several sensors mounted inside the wall of the pipe or vessel. The sensors have a sensor element which checks the remaining wall thickness within the sensor element. A monitoring system for carrying out the above method is described, in which the sensor consists of a cylindrical, pluglike mechanical device inserted into the wall. The sensor includes a sensor element of conductive, easily corroded material such as magnesium metal, and an electrically insulated holder. When the metal in the sensor element is corroded in the region where the wall thickness has been reduced, the electrical circuit is broken and a signal can then be effectively transmitted to a remotely located monitoring center in the form of a power failure signal. 2 figs.

15019 **Device for shutting off pipelines for the transport of bulk products.** Mailliet, P.; Radoux, H.; Ulveling, L.; Loutsch, J.; Lonardi, E. 8 Sep 1990. Filed date 1 Mar 1990. Canada Patent patent application 2011236. 20p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

Known pipeline shutoff devices, used particularly in pneumatic systems for transport of such products as coal dust, typically do not allow the use of the main pressurization of the transport system in order to actuate the device's pneumatic jack. An improved shutoff device is disclosed which takes advantage of the pressure of the pneumatic transport system, obviating the need for a separate compressor to operate the pneumatic jack. The device of the invention comprises a housing with a circular passage orifice, a pivoting closing element in the form of a spherical dome, and a circular gasket surrounding the orifice. The gasket is mounted on an annular support axially displaceable towards the closing element under the action of a pneumatic fluid. For this purpose, the annular support possesses a passive annular surface exposed to the pressure in the housing. The active surface of the support is larger than its passive surface. 8 figs.

15020 **Apparatus and equipment for use in lining pipeline having branched portions.** Shimokawa, Shinji; Kita, Katsuo. 14 Aug 1990. Filed date 20 Dec 1989. Canada Patent patent application 2006117. 34p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

An apparatus is provided for blocking openings of branched pipes in branched portions of a pipeline, adapted for use prior to operation of lining the inner surface of the pipeline. The apparatus includes a base mounted on a turning unit in such a manner that it may be moved radially of the pipeline relative to the turning unit. The turning unit is mounted on an operating machine body movable in the pipeline in such a manner that it may be turned about the longitudinal axis of the pipeline. A sliding member with a spring is supported in the base, and a plate is fixed secured to the base through lower struts. A plug housing member formed by the plate and a plurality of upper struts, each of which has a slit fitted with a spring, is made such that a plurality of plugs is held by the plurality of upper struts and the plate. A plug is also provided for blocking each of the openings in the branched pipeline by means of the above apparatus. The invention enables a blocking operation to be conducted extremely efficiently and in a simple and easy manner during lining of such types of pipelines as gas conduits, water or sewer lines, and petroleum pipelines, notably underground pipelines. 8 figs.

15021 **Three-way valve and liquid distribution pipe comprising same, both adapted to be cleaned by scraping.** Devehat, E. Le. 31 Jul 1990. Filed date 17 Oct 1989. Canada Patent patent application 2000882. 24p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A 3-way valve is provided for a liquid distribution pipe, for example a pipe for distributing oil or petroleum products. If such a pipe is used to distribute several different liquids in succession, it is known to circulate a scraper in the pipe to clean the residues of the previously distributed liquid from the pipe walls and to discharge the residues from the pipe. The valves designed to be fitted into such pipes must be of the kind which allow a scraper to pass through them. Known valves of this type generally feature dead areas which cannot be cleaned by the scraper and/or generate at the junction of the main and branch sections strong turbulence producing significant head losses. An object of this invention is to

overcome these disadvantages by proposing a 3-way valve comprising a main section designed to be connected to the distribution pipe, and a branch section designed to be connected to an inlet/outlet pipe. A mobile obturator adapted for selectively closing off the opening is situated between the branch section and the opening. It comprises a spherical plug through which passes a cylindrical bore and which is adapted to rotate at least 90° about an axis transverse to the axis of the branch section between an open configuration and a closed configuration in which the spherical outside wall of the spherical plug is flush with the internal volume of the main section. The valve of the invention can also be adapted to supply, store, and launch scrapers. 10 figs.

4204 Heat Transfer and Fluid Flow

Refer also to citation(s) 14480, 14537, 14652, 14837, 14875, 15272, 15297, 15511, 15514

15022 (ANL–90/46) **Two-phase flow patterns and frictional pressure gradients in a small rectangular channel: A comparison between two horizontal orientations.** Wambsganss, M.W. (Argonne National Lab., IL (USA)); Jendrzejczyk, J.A.; France, D.M.; Obot, N.T. Argonne National Lab., IL (USA). Nov 1990. 46p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. Order Number DE91009652. Source: OSTI; NTIS; GPO Dep.

In horizontal flow through a rectangular channel, the channel cross section can be oriented so that the long side is either vertical or horizontal. The effect of cross-section orientation on the fluid dynamic characteristics of two-phase flow is of interest in plate-fin heat exchanger design because a heat exchanger can be similarly oriented to operate in either of the two orientations. An earlier study of two-phase flow patterns and frictional pressure gradients in a small rectangular channel with the channel cross section oriented with the long side vertical was performed and reported. This report presents the results of a complementary study of the same channel, but with the channel cross section oriented so that the long side was horizontal. Flow patterns were studied and a flow pattern map, using superficial gas and liquid velocities as co-ordinates, was developed. Measured two-phase frictional pressure drops were analyzed using the concept of two–phase flow multipliers. Results from the two channel orientations were compared. While there are some notable differences in flow patterns at low mass qualities and low mass fluxes, in the practical range of interest for plate-fin heat exchanger design the effects on frictional pressure gradient are minimal and the modified correlation developed from the earlier study is shown to be also applicable for design purposes when the long side is horizontal. 14 refs., 20 figs., 1 tab.

15023 (ANL/CP–72534) **Effects of a friction reducing surfactant on the performance of a shell-and-tube heat exchanger.** Choi, U.S. (Argonne National Lab., IL (USA)); Tran, T.N. Argonne National Lab., IL (USA). [1991]. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-9104191–1: International symposium on fluids for district heating, Copenhagen (Denmark), 10-11 Apr 1991). Order Number DE91008836. Source: OSTI; NTIS; GPO Dep.

The performance of a commercial shell-and-tube heat exchanger with aqueous surfactant solutions has been investigated. The tests were run in the Argonne pilot-scale DHC system simulator using cationic surfactant Kemamine EX-300 at 1000 and 2000 wppM in deionized water, with operating temperature ranging between 79.4°C and 97.8°C. The pressure drop and heat transfer performance of the heat exchanger with the surfactant solutions was compared with that for pure water. The present work suggests that, because the unique pressure drop and heat transfer characteristics of the surfactant solution, it is possible to achieve no heat transfer reduction in the heat exchanger while a significant friction reduction can be achieved in the transmission pipe line. The results of the present work should be useful in the optimal design of heat exchangers for operation with surfactant enriched water. 4 refs., 5 figs.

15024 (CONF-910602–2) **A theory for fluidelastic instability of tube-support-plate inactive modes.** Cai, Y. (Argonne National Lab., IL (USA)); Chen, S.S.; Chandra, S. Argonne National Lab., IL (USA). [1990]. 38p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. From American Society of Mechanical Engineers (ASME) pressure vessels and piping conference; San Diego, CA (USA); 23-27 Jun 1991. Order Number DE91006001. Source: OSTI; NTIS; GPO Dep.

Fluidelastic instability of loosely supported tubes, vibrating in a tube support plate (TSP)-inactive mode, is suspected to be one of the main causes of tube failures in some operating steam generators and heat exchangers. A mathematical model, which incorporates all motion-dependent fluid-forces based on the unsteady flow theory, is presented here for fluidelastic instability of loosely supported tubes exposed to nonuniform crossflow. In the unstable region associated with a TSP-inactive mode, the tube motion can be described by two linear models: TSP-inactive mode when tubes do not contact with the TSP and TSP-active mode when tubes contact the TSP. A bilinear model, consisting of these linear models, is presented in this paper to simulate the characteristics of fluidelastic instability of loosely supported tubes in the stable and unstable region associated with TSP-inactive modes. The analytical results are compared with published experimental data; they agree reasonably well. The prediction procedure presented for fluidelastic instability response of loosely supported tubes is applicable in the stable regions of TSP-inactive mode. 25 refs., 10 figs., 2 tabs.

15025 (DOE/ER/13291–6) **Interphase transport and multistage separations: Progress report, September 1, 1987–February 28, 1991.** Stewart, W.E. Wisconsin Univ., Madison, WI (USA). Dept. of Chemical Engineering. 15 Sep 1990. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-84ER13291. Order Number DE91009627. Source: OSTI; NTIS; GPO Dep.

During this period new matrix formulas were developed for calculation of multicomponent simultaneous heat and mass transfer, thus generalizing the methods given in Paper 2 for isothermal systems. Formulas were given for two choices of state variables: (i) mole fractions and temperature, and (ii) mole fractions and molar enthalpy. The latter choice usually leads to simpler calculations, and was used in our fractionation model. Tom Young also developed a two-phase boundary-layer model and collocation method for steady-state simulation of crossflow sieve trays. During the past year, Young investigated the dimensionless coefficient a_{00} in his boundary-layer model as a function of various sets of dimensionless groups for a sieve tray in quasi-steady operation. He also constructed various correlation forms for his two-phase heat and mass transfer function a_{00}, and fitted them to published sieve-tray fractionation data from three sources. The fitting was done by multiresponse parameter estimation with the subroutine GREG. The variances of the data from the three laboratories were taken into account directly by use of the appropriate multiresponse objective function, with a separate response function for observations from each laboratory. Equal variances were assigned to gas and liquid composition measurements, and mass-balance closure adjustments were optimized by estimating key values for each experiment simultaneously with the parameters of the model considered.

15026 (DOE/ER/13764–T2) **Interfacial characteristic measurements in horizontal bubbly two-phase flow.** Wang, Z.; Huang, W.D.; Srinivasmurthy, S.; Kocamustafaogullari, G. Wisconsin Univ., Milwaukee, WI (USA). Dept. of Mechanical Engineering. Oct 1990. 181p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-87ER13764. Order Number DE91009803. Source: OSTI; NTIS; GPO Dep.

Advances in the study of two-phase flow increasingly require detailed internal structure information upon which theoretical models can be formulated. The void fraction and interfacial area are two fundamental parameters characterizing the internal structure of two-phase flow. However, little information is currently available on these parameters, and it is mostly limited to vertical flow configurations. In view of the above, the internal phase distribution of cocurrent, air-water bubbly flow in a 50.3 mm diameter transparent pipeline has been experimentally investigated by using a double-sensor resistivity probe. Liquid and gas volumetric superficial velocities ranged from 3.74 to 5.60 m/s and 0.25 to 1.59 m/s, respectively, and average void fractions ranged from 2.12 to 22.5%.

The local values of void fractions, interfacial area concentration, mean bubble diameter, bubble interface velocity, bubble chord-length and bubble frequency distributions were measured. The experimental results indicate that the void faction, interfacial area concentration and bubble frequency have local maxima near the upper pipe wall, and the profiles tend to flatten with increasing void fraction. The observed peak void fraction can reach 0.65, the peak interfacial area can go up to 900 $\approx$ 1000 m^2/m^3, and the bubble frequency can reach a value of 2200/s. These ranges of values have never been reported for vertical bubbly flow. It is found that either decreasing the liquid flow rate or increasing the gas flow would increase the local void fraction, the interfacial area concentration and the bubble frequency. 85 refs., 124 figs., 2 tabs.

15027 (DOE/PC/88913–T8) **Mechanics/heat-transfer relation for particulate materials.** Campbell, C.S. University of Southern California, Los Angeles, CA (USA). Dept. of Mechanical Engineering. Jan 1991. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-88PC88913. Order Number DE91008356. Source: OSTI; NTIS; GPO Dep.

This quarter has seen the conclusion of the shear cell study. The author has shown that the apparent thermal conductivity of a sheared granular materials increases linearly with the shear rate. Interestingly enough, the apparent viscosity also varies linearly with the shear rate and it may be argued that both vary as the square root of the granular temperature just as kinetic theory predicts that the viscosity and thermal conductivity of a monatonic hard sphere gas varies as the square root of the thermodynamic temperature. He closes by showing that the apparent Prandtl number of the shared material is a function only of the solid fraction, ν. As a closing summary, he will devote this quarterly report to the discussion of the conductivity measurements. 15 refs., 3 figs.

15028 (EGG-M–90365) **The CERBERUS Ver.02 code: A parallel six-equation thermal-hydraulic- system simulation code.** Makowitz, H. EG and G Idaho, Inc., Idaho Falls, ID (USA). Jan 1991. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-910414–28: International topical meeting on advances in mathematics, computation and reactor physics, Pittsburgh, PA (USA), 28 Apr - 2 may 1991). Order Number DE91010079. Source: OSTI: NTIS; GPO Dep.

CERBERUS, a six-equation parallel thermal-hydraulic system simulation code, has been developed at the Idaho National Engineering Laboratory (INEL). The starting point of CERBERUS is the RELAP5/MOD2.5[4] system simulation code that has been developed for single, central processing unit (cpu), shared memory, Single Instruction Multiple Data (SIMD), computer architectures. The near-term development targets for CERBERUS are shared memory, Multiple Instruction Multiple Data (MIMD), four- to sixteen-cpu machines such as the CRAY X-MP/48 and Y-MP/832, which are respectively, four- and eight-cpu computers. In this paper we will summarize the major features of the CERBERUS Ver. 02 code and our experiences with it on a CRAY Y-MP8/8-128.

15029 (EUR–12464) **A gas-liquid absorber with an integrated heat exchanger for high temperature reactions: Final report.** Legoff, P. (Centre de Recherche d'Innovation et de Formation pour Ingenieurs et Cadres (CRIFIC), 54 - Nancy (France)). Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Centre de Recherche d'Innovation et de Formation pour Ingenieurs et Cadres (CRIFIC), 54 - Nancy (France). 1990. 97p. (In French). Sponsored by Commission of the European Communities, Brussels (Belgium). Contract EN 3E-0041-F (CD). Source: OSTI; NTIS (US Sales Only): Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The objective of this work is to design and construct two prototypes of a gas-liquid absorber consisting of an integrated heat exchanger intended to perform highly endo- and exo-thermic absorptions/reactions with an excellent efficiency. This is a new technique to obtain an absorber-reactor in which the absorbent liquid passes through a macro-porous metallic matrix being an excellent heat conductor and in close contact with the flattened tubes in which the heat carrier fluid flows transferring the extracted heat. A first gas-liquid absorber prototype has been constructed. It consists of a vertical cylindrical column in which a bundle of hollow vertical fins is placed. A heat carrier fluid flows through out these fins in order to extract the reaction heat. Porous packings made of corrugated perforated metal sheets or extended perforated metal sheets are inserted between the fins. A liquid distributor on top of the column sprinkles the porous packing uniformly with the absorbing liquid. This presents a compact ensemble in which the heat exchanger is integrated within the gas-liquid reactor. The second prototype is made of set of parallelipipedic units used alternatively for the heat carrier liquid and the absorbent solution. These units are separated by thin metal sheets which transfer the heat. 150 porous matrices have been tested. They were formed of a package or perforated and corrugated metal sheets as by gratings of different shapes and sizes. About ten of these matrices have been selected. They have heat transfer coefficients, between the wall and the falling solution, of about 10 to 15 kw/m^2 and coefficients of about 2 kw/m^2 between the liquid/vapor absorbent interface and the heat carrier fluid body. A technical-economical function has been proposed for maximizing, taking into account both quality factors of the apparatus: the specific power in kw/m^3 and the specific absorption rate. 6 refs., 64 figs., 4 tabs.

15030 (FRNC-TH–3691) **Study of two-phase flow redistribution between two passes of a heat exchanger.** Mendes de Moura, L.F. Institut National Polytechnique, 38 - Grenoble (France). Apr 1989. 202p. (In French). Order Number DE91762836. Source: OSTI; NTIS (US Sales Only).

The object of the present thesis deals with the study of two-phase flow redistribution between two passes of a heat exchanger. Mass flow rate measurements of each component performed at each channel outlet of the second pass allowed us to determine the influence of mass flow, gas quality, flow direction (upward or downward) and common header geometry upon flow redistribution. Local void fraction inside common header was measured with an optical probe. A two-dimensional two-phase flow computational code was developed from a two-fluid model. Modelling of interfacial momentum transfer was used in order to take into account twp-phase flow patterns in common headers. Numerical simulation results show qualitative agreement with experimental results. Present theoretical model limitations are analysed and future improvements are proposed.

15031 (IFVE-OUNK–89-113) **Secondary effects in spiral heat exchangers.** Ageev, A.I.; Levin, M.V.; Smykov, G.B.; Shamichev, A.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 16p. (In Russian). Order Number DE91623865. Source: OSTI: NTIS (US Sales Only): INIS.

Submitted to Sverkhprovodimost', Fizika. Tekhnologiya.

The results of an experimental investigation of industrial cryogenic spiral tube-fin heat exchangers (HE) and the analysis of the influence of various secondary effects on the HE efficiency are given. Data on longitudinal heat conductivity of the spiral tube-fin HE structure is presented. 14 refs.; 9 figs.; 5 tabs.

15032 (KFK–4820) **Description of turbulent velocity and temperature fields of single phase flow through tight rod bundles.** Monir, C. (Technische Univ. Braunschweig (Germany, F.R.). Inst. fuer Raumflug- und Reaktortechnik). Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Nukleare Sicherheitsforschung: Technische Univ. Braunschweig (Germany, F.R.). Fakultaet fuer Maschinenbau und Elektrotechnik. Feb 1991. 188p. (In German). Order Number DE91764956. Source: OSTI; NTIS (US Sales Only); INIS.

A two-dimensional procedure, VANTACY-II, describing the turbulent velocity and temperature fields for single phase flow in tight lattices is presented and validated. The flow is assumed to be steady, incompressible and hydraulic and thermal fully developed. First, the state of art of turbulent momentum and heat transport in tight lattices is documented. It is shown that there is a necessity for experimental investigations in the field of turbulent heat transport. The presented new procedure is based on the turbulence model VELASCO-TUBS by NEELEN. The numerical solution of the

balance equations is done by the finite element method code VANTACY by KAISER. The validation of the new procedure VANTACY-II is done by comparing the numerically calculated data for the velocity and temperature fields and for natural mixing with the experimental data of SEALE. The comparison shows a good agreement of experimental and numerically computed data. The observed differences can be mainly attributed to the model of the turbulent PRANDTL number used in the new procedure. (orig.).

15033 (LUTFD2-TFRT–5424-1-100-90) **Modelling and simulation of a crossflow heat exchanger.** Halling, L.; Zeidler, T. Lund Univ. (Sweden). Dept. of Automatic Control. Jun 1990. 101p. (In Swedish). Order Number DE91763547. Source: OSTI; NTIS (US Sales Only).

The purpose of this master thesis has been to find a simulation model for a crossflow heat exchanger in an air conditioning plant. The air temperature was controlled by changing the relation between hot water and recirculated water from the heat exchanger. The model which was obtained partly from literature studies was based on physical relations describing the heat transfer and energy balance. The results of the simulations were compared with measured data. We chose to study step responses to changes in the valve position. The step responses were similar to a first order step response with a time delay. The time constant obtained from the simulations showed good agreement with measured data, while the stationary gain in some cases differed more than 30%, although the difference in most cases was less that 20%. (authors).

15034 (NEI-NO–119) **Pressure drop in pipe components in two-phase gas-liquid flow.** Noersteboe, A. Divisjon Kulde NTH-SINTEF, Trondheim (Norway). 1986 109p. Order Number DE91763499. Source: OSTI; NTIS (US Sales Only).

The report presents an experimental study of pressure drop in pipe components in horizontal adiabatic, one-component, liquid-vapour two-phase flow. The pipe components included in the measurements are 90° bends, 180° bends, globe valves, ball valves and butterfly valves. The aim of the study has been to increase the knowledge and calculation accuracy of the pressure drop in pipe components in return lines in refrigeration plants. Some of the main conclusions of the study are: The pressure drop in high loss components is mainly governed by the flow momentum at the inlet of the component. The pressure drop in such components may therefore be calculated with an accuracy of ± 25% by using the usual single-phase pressure drop equation, and by manipulating the velocity-density (i.e. the momentum) term. The manipulation may be performed by deducing a "two-phase density" from a straight pipe pressure drop calculation method with proven validity for the current flow condition. This procedure is similar to equivalent lenght methods. In low loss components the pressure loss due to the phase interaction becomes a relatively large part of the total pressure loss. The measurements show that the pressure loss then is highly mass flux dependent, as the graphs of the measurements have points where the curve breaks, indicating that flow pattern transitions occur. Earlier methods for estimating component pressure drop are seen to overestimate the pressure drop for high loss components, while the pressure drop in low loss components is considerably underestimated. 43 refs., 42 figs., 24 tabs.

4205 Materials Testing

Refer also to citation(s) 14579, 14581, 14873

15035 (CONF-910602–5) **Analytical simulation of nonlinear response to seismic test excitations of HDR-VKL [Heissdampfreaktor-Versuchskreislauf] piping system.** Srinivasan, M.G. (Argonne National Lab., IL (USA)); Kot, C.A.; Mojtahed, M. Argonne National Lab., IL (USA). [1991]. 30p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract W-31109-ENG-38. From American Society of Mechanical Engineers (ASME) pressure vessels and piping conference; San Diego, CA (USA); 23-27 Jun 1991. Order Number DE91006472. Source: OSTI; NTIS: INIS; GPO Dep.

The paper describes the analytical modeling, calculations, and results of the posttest nonlinear simulation of high-level seismic testing of the VKL piping system at the HDR Test Facility in Germany. One of the objectives of the tests was to evaluate analytical methods for calculating the nonlinear response of realistic piping systems subjected to high-level seismic excitation that would induce significant plastic deformation. Two out of the six different pipe-support configurations, (ranging from a stiff system with struts and snubbers to a very flexible system with practically no seismic supports), subjected to simulated earthquakes, were tested at very high levels. The posttest nonlinear calculations cover the KWU configuration, a reasonably compliant system with only rigid struts. Responses for 800% safe-shutdown-earthquake loading were calculated using the NONPIPE code. The responses calculated with NONPIPE were found generally to have the same time trends as the measurements but contained under-, over-, and correct estimates of peak values, almost in equal proportions. The only exceptions were the peak strut forces, which were underestimated as a group. The scatter in the peak value estimate of displacements and strut forces was smaller than that for the strains. The possible reasons for the differences and the effort on further analysis are discussed.

15036 (UCRL-ID–106201) **Quantitative film radiography.** Devine, G.; Dobie, D.; Fugina, J.; Hernandez, J.; Logan, C.; Mohr, P.; Moss, R.; Schumacher, B.; Updike, E.; Weirup, D. Lawrence Livermore National Lab., CA (USA). 26 Feb 1991. 27p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91009718. Source: OSTI; NTIS; INIS; GPO Dep.

We have developed a system of quantitative radiography in order to produce quantitative images displaying homogeneity of parts. The materials that we characterize are synthetic composites and may contain important subtle density variations not discernible by examining a raw film x-radiograph. In order to quantitatively interpret film radiographs, it is necessary to digitize, interpret, and display the images. Our integrated system of quantitative radiography displays accurate, high-resolution pseudo-color images in units of density. We characterize approximately 10,000 parts per year in hundreds of different configurations and compositions with this system. This report discusses: the method; film processor monitoring and control; verifying film and processor performance; and correction of scatter effects.

15037 (UCRL-ID–106556) **Structural analysis of the San Francisco Southern Freeway Viaduct Bent 25.** Kay, G. Lawrence Livermore National Lab., CA (USA). 25 Jan 1991. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91009721. Source: OSTI; NTIS; GPO Dep.

A quarter scale model of one of the bents of the two level San Francisco Southern Freeway Viaduct will be constructed and tested by the Civil Engineering Department of the University of California, Berkeley as part of their program to assist Caltrans in the understanding of reinforced concrete viaduct responses to seismic loading conditions. At the request of the Berkeley investigators, a detailed continuum model of the viaduct section between expansion joints was constructed to assist them in the calibration of their more traditional one dimensional beam finite element models. The continuum model provided resolution of the roadway-bent joint stiffnesses and also provided an estimate of the linear elastic response range of the viaduct section under longitudinal seismic loading. 5 figs., 5 tabs.

15038 (VTT-TUTK–669) **Nordic numerical round robin for a side-grooved ct-specimen.** Talja, H. (Valtion Teknillinen Tutkimuskeskus. Otaniemi (Finland). Ydinvoimatekniikan Lab.). Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Nov 1989. 40p. Order Number DE91624943. Source: OSTI; NTIS (US Sales Only); INIS.

The reliability of fracture mechanics assessments based on finite element method calculations has to be confirmed before making safety assessments for critical components like nuclear pressure vessels. Calculations for simulation of fracture mechanics tests and numerical round robin programmes are useful methods in such verification. In this report the results of Nordic finite element round robin calculations for a side-grooved CT-specimen are presented and compared with experimental results. The round robin consisted of two parts. In the first part two-dimensional calculations assuming

plane strain and plane stress behaviour were made. In the second part extensive three-dimensional calculations were performed for best-estimate analysis of the specimen behaviour. The differences between the solutions were comparatively small. Only one two-dimensional solution, where lower order finite elements were used, deviated clearly from the other ones. A good agreement was seen between two-dimensional plane strain results and experimental results. Three-dimensional calculations corresponded very accurately with each others and the experiment.

15039 **Scraper for liquid distribution pipes, especially for petroleum products.** Devehat, E. Le. 31 Jul 1990. Filed date 17 Oct 1989. Canada Patent patent application 2000885. 17p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A bidirectional scraper is provided for cleaning liquid distribution pipes of constant cross-section, such as those distributing oil, petroleum products, food products, or paint. Currently known scrapers, made of an elastic material and subject to wear, are scrapped in their entirety when worn out. Furthermore, such scrapers do not include any means for guiding them around bends. An object of this invention is to overcome these disadvantages by proposing a scraper comprising an elongate body with two end portions provided with two wear segments on either side of a thinner central portion with a concave external surface. The elongate body is formed by two complementary parts attached to each other by a member forming a nut fastened to one of the parts and a member forming a bolt inserted into the other of the parts. The wear segments are removably mounted around a central portion of the body, axially between two end portions of the body. According to a preferred embodiment of the invention, the end portions are frustoconical. 8 figs.

4210 Combustion Systems

Refer also to citation(s) 14035, 14036, 14037, 14293, 14880

15040 (ENET–8900388/1) **Chimneys for condensing oil-fired furnaces.** Nationaler Energie-Forschungs-Fonds (NEFF), Basel (Switzerland). Mar 1990. 50p. (In German). Order Number DE91765827. Source: OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH).

On the basis of knowledge now at hand, no stainless steels can in future be used in connection with sulphurous fuels, in order that waste water will no longer be contaminated with heavy metal by chimneys and the flue-gas condensers made from such steels. In studies on heavy metals in sewage sludge, high concentrations of nickel and chromium were discovered in condensates. The cause of the heavy corrosion of stainless steels was found in studies conducted by the Laboratory for Chemistry and Corrosion run by Gebr. Sulzer. It is primarily the metals iron and manganese which strongly promote the conversion of sulphurous acid into sulphuric acid and hence unduly accelerate the corrosion within the flue-gas condenser and the chimney installation. As substitute materials for the stainless steel alloys, consideration can be given to the plastics PVDF, PP and PE, enamelled or epoxy-resin coated steel tubing and borosilicate glass, which are all resistant to the materials occurring in flue-gases. Although PP and PE are not yet accepted by the Association of Cantonal Fire Insurances, imminent approval ca be expected. For several years now, ceramic pipes have been imployed in the field of flue-gas condensers. The cost of these remains high at present, but a major expansion of their use could lead to a fall in price. However, plastics could also undoubtedly be used as condenser material in relation to suitable constructions. figs., tabs., 18 refs.

15041 **Method and apparatus for burning liquid fuel.** Anzawa, Norio. 6 Oct 1990. Filed date 29 Mar 1990. Canada Patent patent application 2013302. 30p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A method and apparatus are provided for burning liquid fuel in a wide range of applications from household oil stoves to industrial furnaces. According to the invention, liquid fuel is supplied to the outside of a porous element for instantaneous burning of the fuel in the form of a foam. Air is supplied to the porous element to increase the surface area of the vaporized fuel and to promote the combustion reaction at the same time. Since the liquid fuel is formed into bubbles before being ignited, it can be easily ignited simply by directly contacting an ignition source with the bubbled fuel. 6 figs.

15042 **Pulse combustion apparatus.** Hongo, Ichiro; Saito, Kazuo; Mitani, Akio. 6 Oct 1990. Filed date 30 Mar 1990. Canada Patent patent application 2013491. 41p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A pulse combustion apparatus is provided for use as a heat source in a water heater. The object of the invention is to provide an apparatus which has a tail pipe having a large heat-transmitting surface, therefore requiring no secondary heat exchangers, and which can be made small and easy to manufacture. According to the invention, the apparatus comprises a metal pipe member, an exhaust chamber, and an insert member. The pipe member has two open ends and its inner diameter is uniform over its entire length. The first open end of the pipe member is closed, and the second open end is connected to the exhaust chamber. The insert member is located within the pipe member such that it and the pipe member define a combustion chamber within the pipe member, close to its first end, and also an exhaust passage connecting the combustion chamber to the exhaust chamber and having a cross-sectional area smaller than that of the combustion chamber. The combustion chamber and the exhaust passage constitute a Helmholtz resonator which realizes pulse combustion of the fuel gas. 15 figs.

15043 **Thermal reactor for heaters and fuel generators.** Lavorel, H. 25 Sep 1990. Filed date 13 Feb 1990. Canada Patent patent application 2009853. 16p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A thermal reactor is provided for enhancing combustion and reducing the emission of pollutants. According to the invention, a burner chamber is bounded by a cylindrical wall and a rear wall formed from refractory material and with a central opening for introducing combustion gases. A conical nose section is formed with an exit orifice for the combustion gases on the end of the burner chamber. Positioned spaced-apart from and coextensive with the conical nose section is a frusto-conical shaped deflection means for directing combustion gases toward the nose section. Means coaxial with the burner chamber are positioned between the burner chamber and the deflection means. Prior to exiting the burner chamber, the gases are placed in turbulence and after exiting the burner chamber the gases are reduced in velocity and change direction toward the burner chamber. 3 figs.

15044 **Multi-tube once-through boiler.** Miura, Tamotsu; Kayahara, Toshihiro; Tai, Seiji; Miura, Masotoshi; Sibakawa, Sadayoshi. 31 Jul 1990. Filed date 22 Dec 1989. Canada Patent patent application 2006576. 28p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A multi-tube once-through boiler is provided, having a quadrangular type of boiler body, comprising a feed path for combustion air, a combustion chamber, and an exhaust gas channel passing through a flue. The feed path, combustion chamber, and exhaust gas channel are aligned in substantially the same plane along the lateral walls of the boiler body. A burner duct forming part of the feed path and a blower for use with the boiler are disposed in any desired regions of the lateral wall portions defining the width of the boiler body. The boiler body includes a water tube assembly arranged such that combustion gas flows crosswide to the tubes. A burner is disposed closely adjacent to the first water tube row in the water tube assembly. According to another aspect of the invention, a multi-tube once-through boiler has a quadrangular type body installed on a bed together with ancillary parts. A frame formed of a required number of substantially vertically or horizontally

extending connecting members define a plurality of receiving compartments for the boiler unit. Front and lateral sealing panels are provided for closing an opening in the front surface of the receiving compartments and in each lateral surface of the structure. 14 figs.

4220 Mining and Underground Engineering

Refer also to citation(s) 14279

15045 (SAND–88-7114) **Practical guide for testing and maintenance of high temperature drilling fluids during drilling, coring, logging, and cementing wellbores.** Carney, L.L. (Texas Tech Univ., Lubbock, TX (USA). Dept. of Geosciences); Guven, N. Sandia National Labs., Albuquerque, NM (USA); Texas Tech Univ., Lubbock, TX (USA). Dept. of Geosciences. Feb 1991. 56p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009097. Source: OSTI; NTIS; GPO Dep.

Control of mud weight, fluid rheology, and loss of fluids from the mud system are the most important parameters that must be monitored and controlled during any drilling operation on a mud system. Also, alkalinity control is of paramount importance of systems where the pH is kept below 10.0 because of the differences in the chemical reactions on clays and precipitation of carbonates. Ideally, one must be able to duplicate down-hole conditions of temperature, pressure, shear stress and differential pressure between the column of fluid and the formation. Unfortunately, the instrumentation for monitoring the above is either very scarce, nonexistent, or does not completely duplicate downhole conditions. Therefore, a thorough working knowledge and understanding of chemical reactions from laboratory studies that will take place in a given system under downhole conditions is helpful. There should be a sound scientific foundation established for any phenomenon before attempting to apply it in field procedures and utilization. During the past several years the authors have conducted detailed research on a variety of clay minerals for use as a primary viscosifier for water base drilling fluids. The following is a review of their findings. 6 refs., 6 figs., 3 tabs.

15046 **Extensometric sensor measuring the stress on a boring element and assembly for said sensor.** Morin, P.; Mabile, C. 7 Aug 1990. Filed date 29 Dec 1989. Canada Patent patent application 2006937. 19p. (In French). Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A device is provided to measure, with the aid of gauges, the stresses acting on an drilling element at the bottom of a well. The extensometric sensor of the invention comprises first and second measurement zones connected by cooperative means and fitted with means for mounting the sensor on the drilling element. The first zone is composed of at least two traction strips on which measurement gauges are mounted, connected at their ends by mountings, so as to form a first deformable parallelogram. The traction strips are oriented according to a first direction. The second zone consists of at least two torsion strips on which measurement gauges are mounted, connected at their ends by crosspieces, so as to realize a second deformable parallelogram. The torsion strips are oriented according to a second direction perpendicular to the first direction. The crosspieces and the mountings are generously sized with respect to the torsion and tension strips. 3 figs.

15047 **Drill string equipment information sequence remote control method and device.** Bardin, C.; Pignard, G.; Boulet, J.; Morin, P. 7 Aug 1990. Filed date 29 Dec 1989. Canada Patent patent application 2006938. 20p. (In French). Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A method and device are provided for remotely controlling at least one piece of equipment of a drill string, by means of instructions transmitted from the surface. The method of the invention comprises the following stages. A first information sequence is transmitted from the surface, according to a predetermined sequence. A second sequence resulting from the transmission of the first sequence is detected and compared to another predetermined sequence. In the case where there is similarity between these last 2 sequences, control of the equipment is carried out. The apparatus of the invention comprises means for transmitting and detecting the information, the latter being connected to means for operating the equipment. The transmission means may be drilling fluid pumps, and the detection means may consist of a flowmeter and a flow measurement processing device, and the operating means may be at least one electric valve. The valve can put in communication, when actuated, a reserve of oil under pressure with a chamber whose variation in volume sets the equipment into operation. The equipment may be a variable-angle elbow element or a variable-geometry stabilizer. 6 figs.

4230 Marine Engineering

Refer also to citation(s) 14068, 14076, 14077

15048 (DTH-ISVA-PR–71) **Progress report no. 71.** Danmarks Tekniske Hoejskole, Lyngby (Denmark). Inst. for Stroemningsmekanik og Vandbygning. Apr 1990. 68p. Order Number DE91763368. Source: OSTI; NTIS (US Sales Only).

The report comprises papers produced by researchers at the Institute of Hydrodynamics and Hydraulic Engineering at the Technical University of Denmark. They concern tidal currents in the North Sea, flow separation, turbulence, tidal inlets and bed shear stress measurements in the vicinity of a pipeline in waves. (AB).

4260 Components, Electron Devices and Circuits

Refer also to citation(s) 14655, 14960, 15131, 15255

15049 (CONF-9105135–2) **Parameter correlation of impulse shapes using two-port synthesis.** Googe, J.M.; Ewing, P.D.; Hess, R.A. Oak Ridge National Lab., TN (USA). [1991]. 6p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract AC05-84OR21400. From IEEE instrumentation/measurement technology conference; Atlanta, GA (USA); 14-16 May 1991. Order Number DE91009121. Source: OSTI; NTIS; GPO Dep.

Standard techniques for testing devices and systems for their response to lightning, switching transients, and electromagnetic pulse (EMP) disturbances often call for impulse shapes characterized by double exponential functions. Unfortunately, the time constants and impulse parameters such as rise time, pulse, duration, time to peak, and others are not directly related. The problem in generating test impulses is that the required standard impulses are sometimes defined by parameters and nomenclature lacking direct correlation to the desired time constants needed to derive component values for prototype impulse generator circuits. This paper derives equations for determining the time constants of the double exponential impulse from the commonly used parameters for several standard test impulses. It then proceeds to synthesize a resistor-capacitor (RC) prototype circuit that will produce the desired impulse. The prototype network is realized through a computer-aided design (CAD) procedure using Cauer's RC ladder two-port synthesis method. Descriptions of prototype circuits and test data comparing the theoretical and experimental impulse shapes are also included. The results are a simplified method for determining time constants of a double exponential function from given impulse parameters and a method for deriving the component values for prototype circuits. 7 refs., 8 figs.

15050 (EGG-M–91041) **Characteristics of pulsed nuclear reactor pumped flowing gas lasers.** Neuman, W.A.; Fincke, J.R. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1991]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-910123–21: OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium, Los Angeles, CA (USA), 20-25 Jan 1991). Order Number DE91010054. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Nuclear reactors offer very large energy sources to pump lasers without the need for external power supplies. The large energy deposition possible in nuclear reactor pumped lasers (NRPLs) requires a flowing gas system to control thermal effects. A NRPL

amplifier pumped by charged particles originating in fuel films parallel to a flowing buffer gas is presented. A 10 ms full width half maximum Gaussian reactor pulse is specified and the flow velocity in the cavity is varied to investigate the amplifier behavior for hydrodynamic time scales shorter, comparable, and longer than the reactor time scale. The index of refraction aberration in the cavity is dominated by a tilt in the flow direction and a cylindrical focus transverse to the flow. Higher order aberrations are also significant and exhibit complex behavior during the pulse as the hydrodynamic time scale becomes long compared with the time scale of the reactor pulse. The far field beam quality resulting from the combined 3rd and 4th order aberrations is found to correlate well with the maximum index aberration in the aperture and not with the average power deposition. This correlation breaks down when the 4th order aberrations become significant and the qualitative nature of the aberration changes. 7 refs., 8 figs.

15051 (LA-UR-91-902) **Polymeric-host sulforhodamine-B lasers: Doubled Nd:YAG pumped.** Gettemy, D.J. (Los Alamos National Lab., NM (USA)); Hermes, R.E.; Barnes, N.P. Los Alamos National Lab., NM (USA). [1991]. 4p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9103110–1: Advanced solid-state lasers topical meeting, Hilton Head, SC (USA), 18-20 Mar 1991). Order Number DE91009955. Source: OSTI; NTIS; GPO Dep.

Solid-state dye lasers, pumped by a doubled Nd:YAG laser, were evaluated as a function of concentration, output coupler reflectivity and oscillator dimensions. A slope efficiency of up to 62% was achieved. A maximum irradiance of 59 MW/cm^2 to the dye laser cavity was achieved. 7 refs., 2 figs., 4 tabs.

15052 (LBL–30095) **Nuclear magnetic resonance experiments with dc SQUID amplifiers.** Heaney, M.B. (California Univ., Berkeley, CA (USA). Dept. of Physics). Lawrence Berkeley Lab., CA (USA). Nov 1990. 114p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91009775. Source: OSTI; NTIS; INIS; GPO Dep.

The development and fabrication of dc SQUIDs (Superconducting QUantum Interference Devices) with Nb/Al_2O_3/Nb Josephson junctions is described. A theory of the dc SQUID as a radio-frequency amplifier is presented, with an optimization strategy that accounts for the loading and noise contributions of the postamplifier and maximizes the signal-to-noise ratio of the total system. The high sensitivity of the dc SQUID is extended to high field NMR. A dc SQUID is used as a tuned radio-frequency amplifier to detect pulsed nuclear magnetic resonance at 32 MHz from a metal film in a 3.5 Tesla static field. A total system noise temperature of 11 K has been achieved, at a bath temperature of 4.2 K. The minimum number of nuclear Bohr magnetons observable from a free precession signal after a single pulse is about 2×10^{17} in a bandwidth of 25 kHz. In a separate experiment, a dc SQUID is used as a rf amplifier in a NQR experiment to observe a new resonance response mechanism. The net electric polarization of a $NaClO_3$ crystal due to the precessing electric quadrupole moments of the Cl nuclei is detected at 30 MHz. The sensitivity of NMR and NQR spectrometers using dc SQUID amplifiers is compared to the sensitivity of spectrometers using conventional rf amplifiers. A SQUID-based spectrometer has a voltage sensitivity which is comparable to the best achieved by a FET-based spectrometer, at these temperatures and operating frequencies.

15053 (MLM–3679) **Unipunch capability study.** Sterrett, M.E.; Ramachandran, R.S. EG and G Mound Applied Technologies, Miamisburg, OH (USA). 25 Feb 1991. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-88DP43495. Order Number DE91008825. Source: OSTI; NTIS; GPO Dep.

A universal mechanical operating system (designated the "Unipunch"), which is a flexibly adjustable punching system used at Mound to punch clearance and tooling holes in flexible circuit materials, was studied to determine its capabilities. A designed experiment was done to investigate the possible effects of production variables on the parts produced. Results of the experiment showed that the consistency and reproducibility of the product is independent of such variables as sequence, operator, and removal and reinstallation of die stations, and that those variables which do affect product reproducibility can be easily controlled when the parts are punched for production. The study also showed that the parts punched by the Unipunch system would meet the requirements of Mound's tool certification program and eliminate many hours of inspection. 2 refs., 3 figs., 6 tabs.

15054 (SAND–90-1712C) **Solutions to current induced avalanche burnout.** Wrobel, T.F.; Choate, L.M. Sandia National Labs., Albuquerque, NM (USA). [1990]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910627–1: 8. symposium on space nuclear power system, Albuquerque, NM (USA), 6-9 Jun 1991). Order Number DE90013196. Source: OSTI; NTIS; GPO Dep.

Reviews of normal breakdown and current induced avalanche breakdown mechanisms in silicon power transistors are presented. We show the applicability of the current induced avalanche model to heavy ion induced burnouts. Finally, we present solutions to current induced avalanche in silicon power semiconductors. 7 refs., 5 figs.

15055 (SAND–90-1745C) **Strained quantum well leaky-mode diode laser arrays.** Shiau, T.H. (New Mexico Univ., Albuquerque, NM (USA). Center for High Technology Materials); Sun, S.; Schaus, C.F.; Zheng, K.; Hadley, G.R.; Hohimer, J.P. Sandia National Labs., Albuquerque, NM (USA). [1991]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910123–18: OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium, Los Angeles, CA (USA), 20-25 Jan 1991). Order Number DE91009982. Source: OSTI; NTIS; GPO Dep.

A new type of diode laser array (denoted "leaky-mode" or "antiguided") has recently been reported. Despite their success, these devices are difficult to fabricate since they require a deep wet-chemical etch which must be accurately controlled. The authors report a new strained GaInAs quantum well device structure which is produced by etching a thin (0.12 μm), transparent GaAs waveguide layer. These devices have demonstrated fundamental mode operation up to 2A (172 mW/per facet at 1A) at 1% duty cycle pulsed condition and 700 mA (62.5 mW/per facet) for cw operation. 18 refs., 6 figs.

15056 (SAND–90-2780C) **Conceptual design and system studies for a 600 kW repetitive pulse transformer.** Hall, D.J. (Westinghouse Electric Corp., Pittsburgh, PA (USA). Science and Technology Center); Pavlik, D.; Roach, J.F.; Harjes, H.C. Sandia National Labs., Albuquerque, NM (USA). [1991]. 28p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910640–2: 8. IEEE pulsed power conference, San Diego, CA (USA), 17-19 Jun 1991). Order Number DE91010585. Source: OSTI; NTIS; GPO Dep.

Pulse transformer conceptual design and system studies were conducted at the Westinghouse Science and Technology Center for the Sandia National Laboratories' Repetitive High Energy Pulsed Power (RHEPP) System. The RHEPP system relies on magnetic switches to achieve pulse compression from 120 Hz ac to microsecond pulses. A 600 kW, 120 Hz Westinghouse alternator supplies ac prime power at 10 kV (rms). Two magnetic switching stages will compress the pulses to 115 usec prior to the pulse transformer. The transformer steps the voltage up to 254 kV. The pulse transformer has an 18:1 turns ratio and is capable of continuous duty operation. System studies were conducted to minimize transformer loss and leakage inductance within transformer size constraints. The optimized design had a 3-step nickel iron core with 9 primary turns. 7 refs., 15 figs.

15057 (SAND–90-2900C) **CMOS IC fault models, physical defect coverage, and I_{DDQ} testing.** Fritzemeier, R.R. (Sandia National Labs., Albuquerque, NM (USA)); Soden, J.M.; Hawkins, C.F. Sandia National Labs., Albuquerque, NM (USA). [1991]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910504–1: Custom integrated circuits conference, San Diego, CA (USA), 12-15 May 1991). Order Number DE91010579. Source: OSTI; NTIS; GPO Dep.

The development of the stuck-at fault (SAF) model is reviewed with emphasis on its relationship to CMOS integrated circuit (IC) technologies. The ability of the SAF model to represent common

physical defects in CMOS ICs is evaluated. A test strategy for defect detection, which includes I_{DDQ} testing is presented. 16 refs., 4 figs.

15058 (SAND–90-3189C) **High power light activated semiconductor switches with sub-nanosecond rise time.** Zutavern, F.J.; Loubriel, G.M.; Buttram, M.T.; O'Malley, M.W.; Helgeson, W.D.; McLaughlin, D.L. Sandia National Labs., Albuquerque, NM (USA). [1991]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910690–1: International microwave symposium, Boston, MA (USA), 11-14 Jun 1991). Order Number DE91009250. Source: OSTI; NTIS; GPO Dep.

This paper presents a summary of results from experiments with large GaAs, InP, and silicon photoconductive semiconductor switches (PCSS). Linear and high gain (lock-on) switching modes will be described. We have used individual PCSS to switch voltages as high as 120 kV and currents as high as 4.2 kA and have produced rise times as fast as 200 ps in the linear mode and 600 ps in the initiation of lock-on. The high gain switching mode is important to applications which must be compact or operate at high repetition rates. The highest power which we have switched to date with a pulsed semiconductor laser diode array (100 W) is 40 MW. The potential development of these switches for future applications will also be discussed. 13 refs., 7 figs.

15059 (SAND–91-0381C) **S-parameter measurements and applications of superconducting flux flow transistors.** Martens, J.S. (Sandia National Labs., Albuquerque, NM (USA)); Hietala, V.M.; Zipperian, T.E.; Ginley, D.S.; Tigges, C.P.; Phillips, J.M. Sandia National Labs., Albuquerque, NM (USA). 1991. 25p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. N0017390WR00172. (CONF-910690–2: International microwave symposium, Boston, MA (USA), 11-14 Jun 1991). Order Number DE91009763. Source: OSTI; NTIS; GPO Dep.

The authors have performed microwave two-port S-parameter measurements and modelling on Superconducting Flux Flow Transistors (SFFTSs). These transistors, based on the magnetic control of flux flow in an array of High Temperature Superconducting (HTS) weak links, can exhibit significant available power gain at microwave frequencies (over 20 dB at 7-10 GHz in some devices). The input impedance is largely inductive while the output impedance is resistive and inductive. The characteristics are such that these devices are potentially useful in numerous applications including matched amplifiers. 17 refs., 8 figs., 1 tab.

15060 (SAND–91-0445C) **Experimental study of narrow slot, cavity-backed apertures with finite wall conductivity.** Jedlicka, R.P.; Castillo, S.P.; Warne, L.K. Sandia National Labs., Albuquerque, NM (USA). [1991]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9106118–2: 1991 Institute of Electrical and Electronics Engineers (IEEE) AP-S symposium, Ontario (Canada), 24-28 Jun 1991). Order Number DE91009039. Source: OSTI; NTIS; GPO Dep.

Electromagnetic coupling to electronic components or subsystems is a concern in modern system design. Undesired coupling can cause interference or, in the extreme, system upset. To be able to characterize the coupling is an important step to understanding the limitations on system performance. Often the approach is taken to shield the electronic equipment inside some kind of enclosure. However, there are usually inadvertent cracks or bowing at mechanical interfaces. These gaps are apparent slot apertures. An equivalent antenna/local transmission line model for narrow slot apertures with depth including losses has been developed. It may be applied tortuous paths and hence may be used to model practical situations. This model has been previously verified by measuring the coupling through narrow slot apertures with varying width and depth. These measurements were performed for brass slots radiating into a half-space. The results were in good agreement with the model of Warne and Chen. The models, as well as the measurements showed that for very narrow slots the wall loss becomesdominant – it has been demonstrated that the inclusion of loss is important in making realistic coupling estimates in practical configurations. This paper presents results showing the effects of varying conductivity and surface preparations for half-space coupling as well as different loadings of the narrow slot apertures. The coupling through narrow slot apertures having depth was measured for a variety of resonant cavity loadings. The loadings were chosen such that the cavity resonant frequencies were above, near and below the resonant peak of the half-space coupling curve. Measurements were made in the 2–4 GHz band with vertical polarization. 3 refs., 6 figs., 1 tab.

15061 (SAND–91-0560C) **Recent advances with quiescent power supply current (I_{DDQ}) testing at Sandia using the HP82000.** Righter, A.W.; Leong, D.J.; Cox, L.B. Sandia National Labs., Albuquerque, NM (USA). [1991]. 29p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9104198–1: 1991 international HP 82000 user group meeting, Tampa, FL (USA), 4 Apr 1991). Order Number DE91009254. Source: OSTI; NTIS; GPO Dep.

Last year at the HP82000 Users Group Meeting, Sandia National Laboratories gave a presentation on I_{DDQ} testing. This year, we will present some advances on this testing including DUT board fixturing, external DC PMU measurement, and automatic IDD-All circuit calibration. This paper is geared more toward implementation than theory, with results presented from Sandia tests. After a brief summary I_{DDQ} theory and testing concepts, we will describe how the break (hold state) vector and data formatting present a test vector generation concern for the HP82000. We than discuss fixturing of the DUT board for both types of I_{DDQ} measurement, and how the continuity test and test vector generation must be taken into account. Results of a test including continuity, IDD-All and I_{DDQ} Value measurements will be shown. Next, measurement of low current using an external PMU is discussed, including noise considerations, implementation and some test results showing nA-range measurements. We then present a method for automatic calibration of the IDD-All analog comparator circuit using RM BASIC on the HP82000, with implementation and measurement results. Finally, future directions for research in this area will be explored. 14 refs., 16 figs.

15062 (UCRL-JC–104404) **Collisional excitation x-ray lasers.** Matthews, D.; Chandler, E.; Da Silva, L.; Fields, D.; Goldstein, W.; Keane, C.; Koch, J.; London, R.; MacGowan, B.; Maxon, S.; Nilsen, J.; Osterheld, A.; Rosen, M.; Scofield, J.; Shimkaveg, G.; Stewart, R.; Trebes, J. Lawrence Livermore National Lab., CA (USA). 14 Jan 1991. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9009266–13: 2. international colloquium on X-ray lasers, York (UK), 17-21 Sep 1990). Order Number DE91010467. Source: OSTI; NTIS; GPO Dep.

We will review the progress that has been made at numerous laboratories in the demonstration, optimization and understanding of so-called collisional excitation x-ray lasers, i.e., lasers which involve amplification of the n = 3p to n =3 s transitions in Ne-like ions and the n = 4d – 4p lines in Ni-like ions. Currently, these schemes are producing x-ray lasers which operate from ~32.6 nm to 3.6 nm and with output power into the few MW range. Efficiencies are low ($\leq 10^{-6}$) with the current means of pumping, i.e., with optical laser pumped plasma amplifiers. More efficient schemes may be forthcoming and will be discussed herein. Other important amplifier characteristics such as brightness, divergence and coherence are also being studied and the status of our knowledge of them will be discussed in this manuscript. Finally, we will discuss the prospects for the development and application of compact, moderate cost collisional excitation lasers. 21 refs., 7 figs., 2 tabs.

15063 (UCRL-JC–104650) **A calculation of gain in Ne-like Ag soft x-ray lasers.** Walling, R.S.; Osterheld, A.L.; Scofield, J.H.; Goldstein, W.H.; Rosen, M.D.; Chen, M.H. Lawrence Livermore National Lab., CA (USA). [1990]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9009266–12: 2. international colloquium on X-ray lasers, York (UK), 17-21 Sep 1990). Order Number DE91009758. Source: OSTI; NTIS; GPO Dep.

We describe results from ionization balance calculations and population inversion calculations for Ne-like Ag. We comment on the consistency of our results with recent observations of gain reported from the Nova Two-Beam Facility at Livermore. 7 refs., 2 figs., 1 tab.

15064 (UCRL-JC–105120) **Design calculations for the microchannel heatsink.** Riddle, R.A.; Contolini, R.J.; Bernhardt, A.F. Lawrence Livermore National Lab., CA (USA). 15 Jan 1991. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910292–1: National electronics products conference (NEPCON), Anaheim, CA (USA), Feb 1991). Order Number DE91008730. Source: OSTI; NTIS; GPO Dep.

the microchannel heatsink (MCHS) has been shown to be a very compact, effective heat transfer structure. It has the capability to provide cooling for high speed computer chips, laser diodes arrays, radio and microwave frequency amplifiers and other high power electronic devices. As an example of its capability a 1 kW/cm^2 heat dissipation has been obtained with a 100°C temperature differential between the active device surface and the water coolant. In order to understand and predict the thermal performance of the MCHS using various power devices, different coolants, and structural configurations a computer program MCHSCALC has been written. This program has been verified by comparison to experimental data. 7 refs., 4 figs., 4 tabs.

15065 (UCRL-JC–105285) **High-power performance of a copper laser pumped dye master-oscillator-power-amplifier chain.** Bass, I.L.; Bliss, E.S.; Bonanno, R.E.; Castle, P.M.; Feldman, M.; Hackel, R.P.; Hammond, P.R.; Johnson, S.A.; Kichinski, R.; Neeb, K.P.; O'Neil, R.W.; Paisner, J.A.; Paris, R.D.; Salmon, J.T. Lawrence Livermore National Lab., CA (USA). [1991]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910595–8: CLEO '91: conference on lasers and electro-optics, Baltimore, MD (USA), 12-17 May 1991). Order Number DE91010460. Source: OSTI; NTIS; GPO Dep.

A dye master-oscillator-power-amplifier chain pumped by copper lasers produced 1200 W output at 50% conversion efficiency and >10 kHz pulse repetition frequency. 2 refs., 3 figs.

15066 (UCRL-JC–105286) **43 watt CW Ti:Sapphire laser.** Erbert, G.V.; Bass, I.L.; Hackel, R.P.; Jenkins, S.; Kanz, K.; Paisner, J.A. Lawrence Livermore National Lab., CA (USA). [1991]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910595–7: CLEO '91: conference on lasers and electro-optics, Baltimore, MD (USA), 12-17 May 1991). Order Number DE91010468. Source: OSTI; NTIS; GPO Dep.

Using four argon-ion lasers to pump a 2-rod Ti:Sapphire laser we have achieved 43 watts CW output power at high efficiency with a low order spatial mode. The laser was enclosed in a vacuum system and the rods were cooled with liquid nitrogen to minimize thermally induced aberrations in the rods. 3 refs., 3 figs.

15067 Microwave electric power receiver. Haruyama, Shinichi. 6 Oct 1990. Filed date 29 Mar 1990. Canada Patent patent application 2013424. 14p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

An object of this invention is to provide a microwave electric power receiver which can efficiently generate a dc power free from attenuation, and which can receive a circularly polarized microwave. These objects are achieved by providing a microwave electric power receiver for generating dc power from a microwave received by a microstrip resonator having a line length of half a wavelength of the microwave. The resonator is notched to be split at a longitudinally central portion into two portions. A rectification diode is interposed between notched end portions of the microstrip resonator portions to be matched with those portions. 4 figs.

15068 Method for manufacturing superconducting article. Tachikawa, Kyoji; Shinbo, Yukio; Ono, Moriaki; Kosuge, Shigeyoshi; Kabasawa, Makoto. 15 Sep 1990. Filed date 20 Feb 1990. Canada Patent patent application 2010486. 25p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A method is provided for manufacturing a superconducting article consisting of a superconducting film formed upon the surface of a substrate. According to the invention, a first layer is formed comprising a mixture of $LnBa_2Cu_3O_x$ (compound 1) and Ln_2BaCuO_x (compound 2) on the surface of a substrate, Ln being a rare earth element other than yttrium. The content ratio of compound 2 is within 5-80% of the total amount of compounds 1 and 2. A second layer is then formed on the surface of the first layer. The second layer comprises a mixture of at least CuO and $BaCuO_2$ and has a melting point within the 800-1,000°C range. The mixture in the second layer is melted and kept in the molten state for 1 minute to 4 hours in an oxygen-containing atmosphere in order to cause the resultant melt to diffusion-react with compound 2 in the first layer, thereby converting the first and second layers into a film of a superconducting substance comprising compound 1. The film thus produced is cooled to room temperature. The process of the invention prevents the occurrence of cracks in the film of the superconducting substance, and allows manufacture of a superconducting article having excellent superconducting properties. Experiments are described to illustrate the invention. 5 figs.

15069 Power conversion system. Nakata, Kiyoshi; Kimura, Akira; Takahashi, Youji; Tsutsui, Yoshio; Nakamura, Kiyoshi; Abe, Atsushi. 8 Sep 1990. Filed date 6 Mar 1990. Canada Patent patent application 2011563. 46p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A system is provided for converting an ac voltage of the output of an inverter or an ac power generator for a non-contact current collector used with a magnetically levitated railway, an automobile, or a wind power generator, into a dc voltage. According to the invention, a direct current is taken out of an ac power supply of variable frequency and variable voltage through a pulse width modulation converter in such a manner that in a region of low source voltage, the converter input current is limited to a predetermined value to maximize the dc power taking the voltage drop of the power supply into consideration with the power factor of 1 of the power supply. When the current reaches an allowable maximum, it is limited to that value. In a region of high source voltage, on the other hand, the quadrature component of the input voltage applied to the source voltage is controlled preferentially in a manner to control the converter input voltage below a predetermined value, thus making it possible to secure the maximum power available from the converter over the entire range of operation. If a battery is connected to the dc side, a cooperative operation is made possible while the battery is charged properly. 17 figs.

15070 Superconducting magnet apparatus, cooling system thereof, and electromagnet levitation traveling equipment incorporating the same. Tada, Naofumi; Lida, Fumio; Takizawa, Teruhiro; Kuroishi, Kazuo. 24 Jul 1990. Filed date 6 Dec 1989. Canada Patent patent application 2004689. 40p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A superconducting magnet apparatus comprises one winding of coiled superconductor, another winding of coiled superconductor wire, a cooling device for supplying coolant to cooling vessels which contain the respective windings, and a nonmagnetic partition wall interposed between the cooling vessels to airtightly separate them. The windings are located at relative positions enabling mutual inductance to be effected between them. The apparatus of the invention is intended to be installed on electromagnetically levitated vehicles travelling on a track. The two windings constitute a main conducting winding for normal use and an auxiliary winding for use in an emergency. The two windings are made of coils of different materials, selected for combinational use. The auxiliary winding is arranged closer to associated stator coils laid on an associated track than the main winding is. If a quenching is caused in such a superconducting apparatus, the apparatus is designed not to lose the magnetic repulsive force so that any vehicle travelling at high speed can be safely transferred at least to the nearest station. In addition, the electromagnetic levitation vehicle on which the above apparatus is installed, and a control method for the vehicle, are also described. 13 figs.

43 PARTICLE ACCELERATORS

Refer also to citation(s) 14290, 14291, 14292, 15522, 15555, 15967

15071 (BNL–45935) **Lectures on accelerator physics.** Luccio, A. Brookhaven National Lab., Upton, NY (USA). 11 Mar 1991. 90p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (AGS/AD–91-1;CONF-910195–1-Exc.: School on electromagnetic interactions with intermediate energy hadrons, Folgaria (Italy), 27 Jan - 3 feb 1991). Order Number DE91010376. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains lecture notes on beam dynamics and acceleration concepts in particle accelerators. (LSP)

15072 (BNL–52274) **Brookhaven highlights, October 1, 1989–September 30, 1990.** Rowe, M.S.; Cohen, A.; Greenberg, D.; Seubert, L.; Kuper, J.B.H. (eds.). Brookhaven National Lab., Upton, NY (USA). 1990. 88p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. Order Number DE91010949. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses research being conducted at Brookhaven National Laboratory. Highlights from all the department are illustrated. The main topics are on accelerator development and applications. (LSP)

15073 (GSI–90-29) **Topical problems of accelerator and applied heavy ion physics.** Becker, R.; Deitinghoff, H.; Junior, P.H.; Schempp, A. (eds.). Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Dec 1990. 183p. (In German, English). Order Number DE91764933. Source: OSTI; NTIS (US Sales Only); INIS.

These proceedings contain the articles presented at the named seminar. They deal with high-intensity linacs for heavy ions, the free-electron laser, applications of heavy-ion beams, MEQALAC, the ESR Schottky-diagnosis system, the analysis of GaAs by ion-beam methods, a light-ion synchrotron for cancer therapy, a device for the measurement of the momentum spread of ion beams, the European Hadron facility, the breakdown fields at electrons in high vacuum, a computer program for the calculation of electric quadrupoles, a focusing electrostatic mirror, storage and cooling of Ar beams, the visualization of heavy ion tracks in photographic films, the motion of ions in magnetic fields, the CERN heavy ion program, linear colliders, the beam injection from a linac into a storage ring, negative-ion sources, wake field acceleration, RFQ's, a dense electron target, the matching of a DC beam into the RFQ, electron emission and breakdown in vacuum, and 1-1.5 GeV 300 mA linear accelerator, the production of high-current positive-ion beams, high-current beam experiments at GSI, improvement of the Frankfurt EBIS, the physics of the violin, double layers, beam formation with coupled RFQ's, atomic nitrogen beam for material modification, compact superconducting synchrotron-radiation sources, industrial property rights, a RF ion source for thin film processes, beam-cavity interactions in the RFQ linac, atomic physics with crossed uranium beams, proton linacs, the interdigital H-type structure, injection of H^- beams into a RFQ accelerator, the production of MOS devices by ion implantation, the application of RFQ's, the Frankfurt highly-charged ion facility, RF acceleration techniques for beam current drive in tokamaks, space-charge neutralized transport, and storage rings for synchrotron radiation and free electron lasers. (HSI).

4301 Design, Development, and Operation

Refer also to citation(s) 15083, 15087, 15218, 15523, 15536, 15556

15074 (BNL–45764) **National Synchrotron Light Source User's Manual: Guide to the VUV and x-ray beamlines: Fourth edition.** Gmuer, N.F. (ed.). Brookhaven National Lab., Upton, NY (USA). Feb 1991. 102p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. Order Number DE91009733. Source: OSTI; NTIS; GPO Dep.

The success of the National Synchrotron Light Source in the years to come will be based, in large part, on the size of the user community and the diversity of the scientific disciplines represented by these users. In order to promote this philosophy, the NSLS User's Manual: Guide to the VUV and X-Ray Beamlines-Fourth Edition, is being published. This Manual presents to the scientific community-at-large the current and projected architecture, capabilities and research programs of the various VUV and X-ray beamlines. The Manual is updated periodically in order to keep pace with constant on these beamlines.

15075 (CRN-VIV–74) **Assembly of the Vivitron generator: State of the art on the 29th September 1989.** Heugel, J. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. Sep 1989. 24p. (In French). Order Number DE91767822. Source: OSTI; NTIS (US Sales Only).

The generator construction planning and the Van de Graaf components assembling are shown. The work performed since May 1989 and those in progress are described. The original design, the characteristics and performances, as well as the modifications carried out on the voltage divider are included. The charging system assembling is described.

15076 (CRN-VIV–77) **The Vivitron process control.** Lutz, J.R.; Marsaudon, J.C. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. Oct 1989. 5p. (CONF-891094–: International conference on accelerator and large experimental physics control systems (ICALEPCS), Vancouver (Canada), 30 Oct - 3 nov 1989). Order Number DE91767816. Source: OSTI; NTIS (US Sales Only).

The operation of the VIVITRON electrostatic accelerator designed since 1981 and under construction at the CRN since 1985 needs a dedicated process control set up. The study and design of this control system started in 1987. The electrostatic accelerators are rarely operated by a modern control system. So little knowledge is available in this field. The timing problems are generally weak but the Vivitron specific structure, with seven porticos in the tank and sophisticated beam handling in the terminal, imposes control equipment inside the tank under extreme severe conditions. Several steps are necessary to achieve the full size control system. Some tests in the MP used as a pilot machine supplied practical information about surrounding accelerator conditions inside the tank. They also provided better knowledge of the beam behavior, especially inside the accelerator tube.

15077 (CRN-VIV–79) **Assembly of the Vivitron generator: State of the art on the 1st february 1990.** Heugel, J. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. Feb 1990. 23p. (In French). Order Number DE91767797. Source: OSTI; NTIS (US Sales Only).

The state of the art concerning the Vivitron electrostatic generator on the 1 st February 1990 is reported. The construction planning and the Van de Graaff components assembling are shown. The work performed since September 1989 and those in progress are described. The electrostatic generator finishing requires works to be performed on the electrical and optical interconnections, on the electrodes, on the sensors as well as finishing actions, like the closing of the storage device.

15078 (DESY–90-124) **B-meson factories: Physics, machines and detectors.** Kolanoski, H. (Dortmund Univ. (Germany, F.R.). Inst. fuer Physik). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Oct 1990. 21p. Contract BMFT 054DO51P. (CONF-9005297–: Conference on experimental apparatus for high energy physics and astrophysics, San Miniato (Italy), 28 May - 1 jun 1990). Order Number DE91764661. Source: OSTI; NTIS (US Sales Only); INIS.

This report gives a short survey of the present status of B-meson factory plans and discussions at different laboratories. The physics motivation for an e^+e^- machine running with the highest possible luminosity in the $\Gamma(4S)$ energy region is outlined emphasizing the possibility to observe CP violation in the B-meson system. The technical concepts for such machines together with the basic luminosity limitations are discussed. Finally, the requirements on a detector which is able to cover the rich physics program are presented. (orig.).

15079 (INS-T–500) **Study on RFQ linacs for heavy ions.** Ueda, Nozomu. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Nov 1990. 99p. Order Number DE91767894. Source: OSTI; NTIS (US Sales Only); INIS.

Study on a prdtotype linac 'LITL', the first Radiofrequency Quadrupole (RFQ) linac that accelerated heavy ions in the world,

1.4 m in length and 0.6 m in diameter has revealed: a vane mounting method using 'base plugs' is effective to align the large vanes within a precision of 100 μm: a circle approximation of the ideal vane shape can give a satisfactory rf field distribution in the beam aperture and can yield a high surface field strength exceeding 21 kV/mm. A long RFQ linac 'TALL', 7.3 m in length, has been realized by 'vane separation' method. The cavity has been fabricated by joining four sections which had been assembled independently. The vanes are separated at the joints with gaps between them, which to tolerate machining errors and unequal thermal expansion. This method enables the precise alignment of the vane for a long RFQ. It does not decrease the sparking limit and does not increase beam loss. By devising end inductive tuners, sufficient mode separation was obtained. By compensating the capacitance errors owing to the vane misalignment with side inductive tuners, azimuthal and longitudinal field uniformities of +-1.5 % and +-5 %, respectively have been obtained. The frequency can be controlled without destroying the field uniformity. The cavity is excited stably by a simple loop coupler for a peak rf power up to 240 kW. Beam tests show the output beam characteristics which have been predicted by computer simulations are realized. Through the construction and performance studies of the two linacs, a type of the RFQ linac for heavy ions has been established. (author).

15080 (ITEF–158-89) **Major physical parameters of the ISTRA-56 proton linear accelerator. Part 2.** Vorob'ev, I.A.; Kapchinskij, I.M.; Kozodaev, A.M.; Kolomiets, A.A.; Lipkin, I.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 17p. (In Russian). Order Number DE91625881. Source: OSTI; NTIS (US Sales Only); INIS.

Design parameters of the ISTRA-56 proton linear accelerator matching channel are presented. The beam limiting currents and accelerator energy characteristics are estimated. The values of accepted tolerances are given. 30 refs.; 4 figs.; 3 tabs.

15081 (SAND–90-2883C) **Pulsed power performance of the new RLA [Recirculating Linear Accelerator].** Smith, D.L.; Mazarakis, M.G.; Bennett, L.F.; Olson, W.R. Sandia National Labs., Albuquerque, NM (USA). [1991]. 2p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910640–1: 8. IEEE pulsed power conference, San Diego, CA (USA), 17-19 Jun 1991). Order Number DE91004723. Source: OSTI; NTIS; GPO Dep.

The Recirculating Linear Accelerator (RLA) is returning to operation with a new electron beam injector and a modified accelerating cavity. Upon completion of our experimental program the RLA will capture the injected beam on an IFR guiding plasma channel in either a spiral or a closed racetrack drift tube. The relativistic beam will be efficiently recirculated for up to four passes through two or more accelerating cavities, in phase with the ringing cavity voltage waveforms, and thereby increased in energy to 10 MeV before being extracted. The inductively isolated four-stage injector was designed to produce beam parameters of 4 MeV, 10–20 kA, and 40–55 ns FWHM. The three-line radial cavity is being modified to improve the 1-MV accelerating voltage pulse shape while an advanced cavity design study is in progress. The actual versus predicted pulsed-power performance of the RLA injector and cavity and the associated driving hardware will be discussed in this paper.

15082 (SSCL–371) **The mechanical response of the SSC dipole magnet to ground motion.** Jalloh, A.R.; Viola, R.; Daly, E. Superconducting Super Collider Lab., Dallas, TX (USA). Mar 1991. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-89ER40486. (CONF-910340–6: International industrial symposium on the super collider, Atlanta, GA (USA), 13-15 Mar 1991). Order Number DE91011003. Source: OSTI; NTIS; INIS; GPO Dep.

One of the requirements for successful performance of the Superconducting Super Collider (SSC) particle beam accelerator is minimization of the effects of ground motion on the beam path. It is therefore important to be able to quantify this effect. To achieve this objective, a finite element dynamic model of the 40 mm dipole magnet was developed and validated with experimental data. The natural frequencies and mode shapes predicted by the model were in good agreement with experimental data. The model was used to predict beam path displacement resulting from ground motion. The magnitude and frequency of the ground motion had been previously measured at the SSC site in Ellis County, Texas. 9 refs., 9 figs., 2 tabs.

4302 Beam Dynamics, Field Calculations, and Ion Optics

Refer also to citation(s) 15100, 15144, 15154

15083 (BNL–45802) **Spatial dynamics of picosecond CO_2 laser pulses produced by optical switching in Ge.** Pogorelsky, I. (Spectra Technology, Inc., Bellevue, WA (USA)); Fisher, A.S.; Veligdan, J.; Russell, P. Brookhaven National Lab., Upton, NY (USA). [1991]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016 ;AC06-83ER40128. (CONF-910123–22: OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium, Los Angeles, CA (USA), 20-25 Jan 1991). Order Number DE91010368. Source: OSTI; NTIS; INIS; GPO Dep.

The design, test and optimization of a picosecond CO_2 pulse-forming system are presented. The system switches a semiconductor's optical characteristics at 10 μm under the control of a synchronized 1.06-μm Nd:YAG picosecond laser pulse. An energy-efficient version of such a system using collimated beams is described. A simple, semi-empirical approach is used to simulate the switching process, specifically including the spatial distributions of the laser energy and phase, which are relevant for experiments in laser-driven electron acceleration. 11 refs., 7 figs.

15084 (BNL–45923) **Transition crossing in the RHIC.** Wei, J. Brookhaven National Lab., Upton, NY (USA). Mar 1991. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (AD/RHIC–84). Order Number DE91009842. Source: OSTI; NTIS; INIS; GPO Dep.

This report summarizes the study of various longitudinal problems pertaining to the transition-energy crossing in the proposed Relativistic Heavy Ion Collider. Scaling laws are provided for the effects of chromatic non-linearity, self-field mismatch, and microwave instability. It is indicated that the beam loss and bunch-area growth are mainly caused by the chromatic non-linear effect, which is enhanced by the space-charge force near transition. Computer simulation using the program TIBETAN shows that a "γ_T-jump" of about 0.8 unit within a time period of 60 ms is adequate to achieve a "clean" crossing, provided that the remnant voltage of the 160 MHz rf system is less than 10 kV. 13 refs., 5 figs.

15085 (BNL–45958) **Long term stability in RHIC.** Parzen, G. Brookhaven National Lab., Upton, NY (USA). Mar 1991. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (AD/RHIC–85). Order Number DE91010183. Source: OSTI; NTIS; INIS; GPO Dep.

This study of long term stability in RHIC appears to indicate that the dynamic aperture depends on the number of turns the particles are required to survive. The dynamic aperture will decrease as the number of turns is increased. This effect is a non-linear orbit effect, and is present in the absence of synchrotron oscillations or tune ripples, although the presence of synchrotron oscillations or tune ripple may make the effect worse. The effect appears to depend on the choice of β^*. It is an appreciable effect for $\beta^* = 2$ and barely noticeable for $\beta^* = 6$ in RHIC. Thus, the long term stability effects can be reduced by increasing β^*, and accepting the associated loss in luminosity. So far, this study does not include synchrotron oscillations, which may change the results reported here. 2 refs., 16 figs.

15086 (BNL–45959) **Populating 114 buckets by bunch shifting: Study on Cottingham's scheme.** Wei, J.; Ruggiero, A.G. Brookhaven National Lab., Upton, NY (USA). Mar 1991. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (AD/RHIC–86). Order Number DE91010148. Source: OSTI; NTIS; INIS; GPO Dep.

Cottingham proposed a scheme to populate 114, instead of 57, rf buckets at the RHIC injection, which employes a low-Q rf system of maximum 40 kV in addition to the original rf system to shift the particle bunches azimuthally along the ring. The first part of this report studies the adiabatic condition required by this scheme. It is

shown that the entire process can be accomplished during a time shorter than the cycling period of the AGS. Results of computer simulation, which are presented in the second part, indicate that particle loss is negligible during the manipulation of the 0.3 eV·s/u $^{197}Au^{79+}$ bunches. 5 refs.

15087 (BNL–52285) **The grating as an accelerating structure.** Fernow, R.C. Brookhaven National Lab., Upton, NY (USA). Feb 1991. 45p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. Order Number DE91010297. Source: OSTI; NTIS; INIS; GPO Dep.

This report considers the use of a diffraction grating as an accelerating structure for charged particle beams. We examine the functional dependence of the electromagnetic fields above the surface of a grating. Calculations are made of the strength of the accelerating modes for structures with π and 2π phase advance per period and for incident waves polarized with either the E or H vector along the grooves of the grating. We consider examples of using gratings in a laser linac and in a grating lens. We also briefly examine previous results published about this subject. 36 refs.

15088 (CRN-VIV–75) **Equipment for the Vivitron beam.** Rebmeister, R. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. Sep 1989. 9p. (In French). Order Number DE91767793. Source: OSTI; NTIS (US Sales Only).

The state of the art of the various Vivitron components on the 30th September 1989 is given. In the injector system, the status of the power supply, the insulating transformer, the 75 degrees dipole, the platform and the pumping system are summarized. The tests performed on the guidance and focalization equipment are described. The type of power supply system adopted is justified. The optical problems of the asymmetric mode are listed. The characteristics of the Vivitron analysis magnet are included.

15089 (DESY–90-113) **Intra-beam scattering in presence of linear coupling.** Piwinski, A. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Sep 1990. 19p. Order Number DE91764669. Source: OSTI; NTIS (US Sales Only); INIS.

The rise times of bunch dimensions and energy spread due to intra-beam scattering in presence of linear coupling between horizontal and vertical betatron oscillations are calculated. The distribution of skew quadrupoles and solenoids along the ring is taken into account as well as the variation of amplitude functions and dispersions. The result is represented as a single integral. (orig.).

15090 (IFVE-OUNK–89-124) **High-frequency longitudinal bunched beam instability.** Balbekov, V.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 17p. (In Russian). Order Number DE91624830. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to the journal At. Ehnerg.

Some models are considered which are used for description of a longitudinal bunched beam instability in a cyclic accelerator. The main attention is given to microwave (turbulent) instability. The idea of beam conductivity matrix is introduced, the general formula is obtained and some extreme cases are investigated. The sufficient stability condition like Boussard criterion is obtained for a beam which is interacting with high-frequency wide-band impedance. The resonance impedance is investigated in detail and the necessary stability condition is obtained. It is shown that a violation of the Boussard criterion leads to sharp intensification of bunch reaction on external perturbation as static effects. The usual instability is impossible in practice because its threshold is not depending on bunch factor of the beam. 16 refs.

15091 (KEK–90-14) **Intrabeam scattering in stochastic approach.** Mori, Yoshiharu. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Oct 1990. 26p. Order Number DE91767925. Source: OSTI; NTIS (US Sales Only); INIS.

Beam emittance growth caused by intrabeam scattering in particle accelerators is examined in a stochastic approach with the Fokker-Planck equation. The results are compared with ordinary analysis based on binary Coulomb collisions which have been developed by Bjorken and Mtingwa. (author).

15092 (KFTI–89-1) **Non-stationary theory of relativistic carcinotron with additional feedback.** Bondarenko, V.A.; Ostrovskij, A.O.; Tkach, Yu.V. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1989. 11p. (In Russian). Order Number DE91624831. Source: OSTI; NTIS (US Sales Only); INIS.

Consideration is given to results of theoretical study of the influence of additional feedback due to wave reflection on the faces of corrugated waveguide on dynamics of excitation of high-frequency oscillations by relativistic electron beam. Self-consistent system of equations describing nonlinear dynamics of beam interaction with corrugated waveguide segment is obtained. Numerical analysis of this system of equations is conducted for different values of beam current and reflection coefficients. It is shown that introduction of additional feedback in the beam-backward wave system leads to formation of self-modulation mode of oscillation generation. It is established that starting current of self-modulation in the system with additional feedback is lower as compared to completely consistent system. The optimal mode of wave excitation from the viewpoint of achieving the maximal efficiency is determined. 14 refs.; 6 figs.

15093 (KFTI–89-4) **Presentation of Green function for rectangular waveguide as an infinite sum of tensor spherical waves.** Popov, V.A.; Cherkasova, K.P.; Khizhnyak, N.A. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1989. 5p. (in Russian). Order Number DE91624832. Source: OSTI; NTIS (US Sales Only); INIS.

Presentation of tensor Green function for rectangular waveguide in the form of an infinite sum of tensor spherical waves is obtained. Each summand of the sum corresponds to one of mirror reflections of source points located in the cavity on waveguide walls. The generalized Poisson summation formula is used for derivation. The obtained presentation of Green function can be used for solution of inner boundary-value problem of electrodynamics in the case of rectangular waveguide with account of reflection from its walls. 10 refs.

15094 (KFTI–89-5) **Current limits for axially symmetrical electron beams with nonuniform current density radial distribution.** Azovskaya, Z.A.; Aseev, G.G.; Papkovich, V.G. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1989. 10p. (In Russian). Order Number DE91624833. Source: OSTI; NTIS (US Sales Only); INIS.

Numerical methods are used to determine values of current limits for continuous and hollow electron beams (EB) with uniform and nonuniform current density distribution over cross section during their movement in long metallic screens. The presented data cover practically the whole range of change of main geometric parameters of systems with high-current EB applied in experimental studies and can be used for preliminary estimation of current limits in lines of EB transport. 4 refs.; 7 figs.

15095 (KFTI–89-7) **Two-beam mechanism theory for charged particle acceleration in spatially periodical structure.** Balakirev, V.A.; Ostrovskij, A.O.; Tkach, Yu.V. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1989. 10p. (In Russian). Order Number DE91624834. Source: OSTI; NTIS (US Sales Only); INIS.

Results of theoretical study of two-beam schemes of charged particle acceleration in a corrugated resonator are presented. High-current beam is used in these schemes for excitation of electromagnetic waves accelerating particles of the second beam. It is shown that conditions for high-effective acceleration can be created using field heterogeneity over the resonator cross section. For this purpose the electron beam exciting HF-field should be injected to the region where the field is minimal (on the axis of corrugated resonator) and accelerated electrons - to the region where it achieves the maximum. Consideration is given to the case when high-current electron beam is in synchronism with the first spatial harmonic of electromagnetic system and accelerated particles - with the main harmonic. This is two-resonance acceleration scheme. Amplitude of the main harmonic exceeds sufficiently the amplitude of the first one at small depth of corrugation. As a result the intensity of accelerating field will be much higher than intensity of deceleration field. It is shown that in this case effective increment in accelerated particle energy can be achieved. 14 refs.; 5 figs.

15096 (LAL–9050) **On measurement of beam size in linear colliders using beamstrahlung and pair creation.** Baier, V.N.

(Paris-11 Univ., 91 - Orsay (FR). Lab. de l'Accelerateur Lineaire); Katkov, V.M.; Strakhovenko, V.M. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Jul 1990. 11p. Order Number DE91767811. Source: OSTI; NTIS (US Sales Only).

It is proposed to use exponential dependence of a photon or pair spectra on a field strength of the beam in linear collider for measurement the size of the beam.

15097 (NIIEFA-P-V–0810) **Comparison of the efficiency of perspective methods for calculation of electric potential in regions with complex configuration of boundaries.** Baranova, M.G.; V'yuga, E.N.; Tikhomirov, A.S. Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR). 1989. 7p. (In Russian). Order Number DE91624835. Source: OSTI; NTIS (US Sales Only); INIS.

The problem of determining the charged particle beam parameters at the inlet to an accelerating system occurs in the process of developing linear electron and ion accelerators. The first step in solving this problem consists in the calculation of electrostatic field in electron-optical systems. Program complexes for solving finite-difference analogue of the Laplace equation are developed. A comparative analysis of the efficiency of applying variable-triangle method with minimal closing errors and the method of line run with the upper relaxation to solve this problem is considered. Identical results within the limits of the scheme accuracy as well as coincidence by calculation time and the required operative memory are obtained in the test problems. 6 refs.; 5 figs.

15098 (NIKHEF-K-LINO–1989-6) **The HS6000/20 development system.** Schimmel, F. (NIKHEF-K, Amsterdam (Netherlands). Afdeling GVT); Pool, S. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K. Apr 1989. 17p. (In Dutch). Order Number DE91625882. Source: OSTI; NTIS (US Sales Only); INIS.

Trainee report of Sandra Pool, supervised by F. Schimmel.

In the actual control system of MEA, NIKHEF-K three color displays are in use for graphical representation of the accelerator status information. At the moment the quality of the color displays is bad. The HS6000 development system of the English company Syntel seems to offer a possible solution to replace these displays. In the development system software is developed which finally may run on a target module. The target module, consisting of a processor card with memory and RS232 port and a graphical card, takes care for the control of a color display. The institute has disposed of an experimental set up during two weeks in order to investigate the possibilities and limitations of the development system. The HS6000 development system runs under the OS-9 multi-user and multi-tasking operating system. The operating system takes care for a part of the necessary software to render a computer valuable. The OS-9 operating system disposes of about 60 utility commands. A feature of OS-9 is the application of modular software technique which are based upon memory modules. The interface between the user and the internal functions of the operating system is formed from the shell, the OS-9 command-interpreter code. The software, which has to run on the target module, is written with the help of the Mmacs screen editor, the draw program and the medit editor. The draw program and the medit editor form part of the EGOS (Enhanced Graphical Output Software) packet. The EGOS packet is a multi-tasking graphical interface for the OS-9 operating system. (author). 1 fig.

15099 (SSCL–308) **Constant of Motion and dynamic equations for one-dimensional autonomous system and radiation damping.** Lopez, G. Superconducting Super Collider Lab., Dallas, TX (USA). Sep 1990. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-89ER40486. Order Number DE91011002. Source: OSTI; NTIS; INIS; GPO Dep.

The dynamic equations for a one-dimensional autonomous system along with their dynamic transformations are expressed in terms of the Constant of Motion of the system. The relation between Liouville's theorem and Hamilton's equations with the Constant of Motion is studied. This approach is applied to the radiation damping suffered by a charged particle inside the beam circulating around a collider-ring accelerator. 12 refs., 3 figs.

4303 Auxiliaries and Components

Refer also to citation(s) 15075, 15077, 15088, 15098, 15142, 15143, 15151, 15152, 15155, 15176, 15949

15100 (ANL/CP–72647) **Electromagnetic field-computation for particle accelerators, today and tomorrow.** Turner, L.R.; Kettunen, L. Argonne National Lab., IL (USA). [1991]. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-9102103–1: 3. seminar on computational electromagnetics, Tokyo (Japan), 4-5 Feb 1991). Order Number DE91010569. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper, we first review the magnets needed in accelerators, then discuss computations for accelerator magnets performed with present codes, and finally describe a new volume integral code which shows promise, and should be suitable for parallel computation. 9 refs., 10 figs.

15101 (BNL–44530) **Coil and iron design for SSC 50 mm magnet.** Gupta, R.C.; Kahn, S.A.; Morgan, G.H. Brookhaven National Lab., Upton, NY (USA). [1990]. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-901194–16: American Society of Mechanical Engineers (ASME) winter annual meeting, Dallas, TX (USA), 25-30 Nov 1990). Order Number DE91010373. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper we present the design of the two dimensional coil and iron cross section, referred to as DSX201/W6733, for the 50 mm aperture dipole magnet being built at the Brookhaven National Laboratory for the Superconducting Super Collider (SSC). The computed values of the allowed field harmonics as a function of current, the quench performance predictions, the stored energy calculations, the effect of random errors on the coil placement and the Lorentz forces on the coil will be presented. The yoke has been optimized to reduce iron saturation effects on the field harmonics. We shall present the summary of this design which will include the expected overall performance of this cross section. 4 refs., 8 figs., 12 tabs.

15102 (BNL–45389) **Siberian Snake solenoid for the AGS.** Ratner, L. G. Brookhaven National Lab., Upton, NY (USA). [1991]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-910505–2: Particle accelerator conference, San Francisco, CA (USA), 6-9 May 1991). Order Number DE91009826. Source: OSTI; NTIS; INIS; GPO Dep.

Recent experiments at the Indiana University Cyclotron Facility (IUCF) have demonstrated that "Siberian Snakes" can be used to preserve the polarization of an accelerated polarized beam in a circular accelerator. Retrofitting full snakes into accelerators such as the Alternating Gradient Synchrotron (AGS) at Brookhaven is almost impossible due to space limitations, but a partial snake that can correct depolarization due to imperfection resonances with 1/20 to 1/30 of a full strength snake seems to present a viable option. We describe such a device for the AGS and give the design criteria in terms of simplicity of accelerator operation and level of achievable polarization. 2 refs., 5 figs., 1 tab.

15103 (BNL–45396) **Emittance correction of photocathode gun.** Gallardo, J.C. (Brookhaven National Lab., Upton, NY (USA)); Palmer, R.B. Brookhaven National Lab., Upton, NY (USA). [1990]. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9009166–21: 12. international free electron laser conference (FEL-12), Paris (France), 17-21 Sep 1990). Order Number DE91010364. Source: OSTI; NTIS; INIS; GPO Dep.

The standard emittance calculation removes linear correlations between transverse displacement r and the divergence r′. Higher order correlations remain and they are responsible for a substantial area in phase space which corresponds to the calculated emittance. Time dependent correlations are identified and different procedures (transverse and longitudinal laser shaping, rf quadrulope) are proposed to remove them. The Brookhaven National Laboratory rf gun has been studied; however, in order to more clearly demonstrate the desired effects, the accelerating field and bunch length have been assumed to be more optimistic than the present operating values. This approach reduces the realizable emittance by a factor of 5 with respect to the value before the correction. 9 refs., 5 figs., 1 tab

15104 (BNL–45801) **Quadrupole magnets measurement.** Wang, Xijie (California Univ., Los Angeles, CA (USA). Center for Advanced Accelerators Physics); Sylvester, C. Brookhaven National Lab., Upton, NY (USA). [1991]. 35p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. Order Number DE91010361. Source: OSTI; NTIS; INIS; GPO Dep.

A rotating coil setup is designed for quadrupole magnet measurement at the Accelerator Test Facility (ATF); Hall probe measurement was also performed for one of each type of quadrupole magnet. Both mechanical and magnetic properties of the quadrupole magnets were measured, the results are reported here. 5 refs., 12 figs., 12 tabs.

15105 (BNL–45949) **Dynamic displacements of the RHIC dipole cold mass with injection molded composite posts during quench conditions.** Sondericker, J. Wolf, L.J. Brookhaven National Lab., Upton, NY (USA). Feb 1991. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (AD/RHIC–83). Order Number DE91009841. Source: OSTI; NTIS; INIS; GPO Dep.

The new design of the RHIC dipole magnets incorporate helium containment bellows having a convolution diameter of only 7.63 inches. The present bellows are 12.80 inches in diameter. The smaller bellows present a substantially reduced pressure area which can be expected to reduce proportionately the end force on the cold mass during a quench. But, the objection was raised that the smaller bellows would present greater obstruction to the helium flow during a quench thereby producing higher pressure differentials. This analysis was undertaken to address these assertions by predicting the dynamic displacements of the cold mass using the latest test data on the stiffness of the IMC posts, pressure-time histories acquired from the recent full cell tests of RHIC magnets, and the dimensions of the new expansion joints. The analysis treated the cold mass as an elastic body having a saggittal curvature. The technique of normal mode expansion of a lumped-parameter system was used to obtain the results and conclusions reported herein.

15106 (CERN–90-02) **Feasibility study for a B-meson factory in the CERN ISR tunnel.** Nakada, T. (ed.). European Organization for Nuclear Research, Geneva (Switzerland); Paul Scherrer Inst. (PSI), Villigen (Switzerland). 30 Mar 1990. 97p. (PSI-PR–90-08.). Order Number DE91624911. Source: OSTI; NTIS (US Sales Only); INIS.

A feasibility study has been made for a B-meson factory, using the ISR tunnel and the LEP injector at CERN. An electron-positron collider operated with asymmetric beam energies of 8 and 3.5 GeV at a luminosity of 10^{34} $cm^{-2}s^{-1}$ will permit decisive answers on the question of CP violation within the framework of the Standard Model. This report outlines the physics motivation and detector requirements and gives a description of the machine design. It is proposed that the design goal is reached in two stages, with a collider with two rings of equal size. In the first stage a luminosity of 10^{33} $cm^{-2}s^{-1}$ may be achieved, allowing a rich programme of charm, beauty and τ-lepton physics. A further tenfold increase of the luminosity would require additional R and D on various machine aspects. (orig.).

15107 (CONF-9011136–) **Proceedings of the 10th International workshop on ECR Ion sources.** Meyer, F.W.; Kirkpatrick, M.I. (eds.). Oak Ridge National Lab., TN (USA). Jan 1991. 380p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 10. international workshop on electron cyclotron resonance ion sources (ECRIS); Knoxville, TN (USA); 1-2 Nov 1990. Order Number DE91010494. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains papers on the following topics: Recent Developments and Future Projects on ECR Ion Sources; Operation of the New KVI ECR Ion Source at 10 GHz; Operational Experience and Status of the INS SF-ECR Ion Source; Results of the New "ECR4" 14.5 GHz ECRIS; Preliminary Performance of the AECR; Experimental Study of the Parallel and Perpendicular Particle Losses from an ECRIS Plasma; Plasma Instability in Electron Cyclotron Resonance Heated Ion Sources; The Hyperbolic Energy Analyzer; Status of ECR Source Development; The New 10 GHz CAPRICE Source; First Operation of the Texas A&M ECR Ion Source; Recent Developments of the RIKEN ECR Ion Sources; The 14 GHz CAPRICE Source; Characteristics and Potential Applications of an ORNL Microwave ECR Multicusp Plasma Ion Source; ECRIPAC: The Production and Acceleration of Multiply Charged Ions Using an ECR Plasma; ECR Source for the HHIRF Tandem Accelerator; Feasibility Studies for an ECR-Generated Plasma Stripper; Production of Ion Beams by using the ECR Plasmas Cathode; A Single Stage ECR Source for Efficient Production of Radioactive Ion Beams; The Single Staged ECR Source at the TRIUMF Isotope Separator TISOL; The Continuous Wave, Optically Pumped H^- Source; The H^+ ECR Source for the LAMPF Optically Pumped Polarized Ion Source; Present Status of the Warsaw CUSP ECR Ion Source; An ECR Source for Negative Ion Production; GYRAC-D: A Device for a 200 keV ECR Plasma Production and Accumulation; Status Report of the 14.4 GHZ ECR in Legnaro; Status of JYFL-ECRIS; Report on the Uppsala ECRIS Facility and Its Planned Use for Atomic Physics; A 10 GHz ECR Ion Source for Ion-Electron and Ion-Atom Collision Studies; and Status of the ORNL ECR Source Facility for Multicharged Ion Collision Research.

15108 (CRN-VIV–81) **The Vivitron resistors.** Osswald, F.; Villemin, C. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. Jan 1990. 24p. (In French). Order Number DE91767795. Source: OSTI; NTIS (US Sales Only).

The results of the tests performed on the 600 Mω Metallux resistors are discussed. The aim of the investigation was to study the influence of the pressure and voltage on the resistivity. 24 resistors were examined. The constant voltage experimental device is described. The tests were performed at different SF6 pressures. The resistor's mean value is 595.5 +- 24 Mω for any pressure and voltage.

15109 (FEI–2012) **System for formation of ion beam timing structure in the EhG-1 accelerator.** Bokhovko, M.V.; Voevodskij, A.A.; D'yachenko, P.P.; Kanaki, V.N.; Kononov, V.N.; Romanov, V.A.; Sotnikov, P.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1989. 4p. (In Russian). Order Number DE91624872. Source: OSTI; NTIS (US Sales Only); INIS.

A system for formation of ion current pulses in the EhG-1 FEI 4.5 MeV and 0.5 mA electrostatic proton accelerator permitting a wide range variation of pulse duration and frequency including single-pulse operation is described. A system for formation of proton beam time structure due to its flexibility happened to be quite useful for experiments on below-threshold diagnostics during proton excitation of different media of atomic iodine laser that is one of perspective candidates as a driver of laser fusion facilities. 5 refs.; 1 fig.

15110 (FEI–2022) **Calculation of irradiated target surface temperature.** Mironov, V.N.; Krasnov, N.N.; Konyakhin, N.A.; Degtyareva, I.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1989. 14p. (In Russian). Order Number DE91624912. Source: OSTI; NTIS (US Sales Only); INIS.

Irradiation regime providing for high radionuclide accumulation should not permit any overheating of the irradiated target surface. Methods of obtaining analytical expressions for calculating the surface temperature of targets irradiated in a cyclotron are described. Comparison of experimentally measured and calculated temperature values for targets with different irradiation elements is conducted. Measured and calculated temperature values demonstrate a good agreement. 7 refs.; 2 figs.

15111 (FNAL/C–91/69) **Shielding calculations for SSC.** Van Ginneken, A. Fermi National Accelerator Lab., Batavia, IL (USA). Mar 1990. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. (CONF-910340–3: International industrial symposium on the super collider, Atlanta, GA (USA), 13-15 Mar 1991). Order Number DE91010328. Source: OSTI; NTIS; INIS; GPO Dep.

Monte Carlo calculations of hadron and muon shielding for SSC are reviewed with emphasis on their application to radiation safety and environmental protection. Models and algorithms for simulation of hadronic and electromagnetic showers, and for production and

transport of muons in the TeV regime are briefly discussed. Capabilities and limitations of these calculations are described and illustrated with a few examples. 12 refs., 3 figs.

15112 (FNAL-TM-1380) **Mechanical Safety Subcommittee guideline for design of thin windows for vacuum vessels.** Western, J.L. Fermi National Accelerator Lab., Batavia, IL (USA). 6 Mar 1991. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. Order Number DE91009983. Source: OSTI; NTIS; INIS; GPO Dep.

This guideline specifies the usage of thin windows for vacuum vessels in terms of their design and application at Fermilab.

15113 (FNAL-TM-1731) **Initial results from 50mm short SSC dipoles at Fermilab.** Bossert, R.C.; Brandt, J.S.; Carson, J.A.; Coulter, K.; Delchamps, S.; Ewald, K.D.; Fulton, H.; Gonczy, I.; Gourlay, S.A.; Jaffery, T.S.; Kinney, W.; Koska, W.; Lamm, M.J.; Strait, J.B.; Wake, M.; Gordon, M.; Hassan, N.; Sims, R.; Winters, M. Fermi National Accelerator Lab., Batavia, IL (USA). Mar 1991. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. (CONF-910340-7: International industrial symposium on the super collider, Atlanta, GA (USA), 13-15 Mar 1991). Order Number DE91010912. Source: OSTI; NTIS; INIS; GPO Dep.

Several short model SSC 50 mm bore dipoles are being built and tested at Fermilab. Mechanical design of these magnets has been determined from experience involved in the construction and testing of 40 mm dipoles. Construction experience includes coil winding, curing and measuring, coil end part design and fabrication, ground insulation, instrumentation, collaring and yoke assembly. Fabrication techniques are explained and construction problems are discussed. Similarities and differences from the 40 mm dipole tooling and management components are outlined. Test results from the first models are presented. 19 refs., 12 figs.

15114 (IAE-4679-11) **Design features and thermal-physical characteristics of low-temperature irradiation channel of the FAKEL electron linac fast neutron source.** Volkova, N.M.; Egorenkova, T.P.; Kiknadze, G.I.; Chushkin, Yu.V.; Shaposhnikov, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 20p. (In Russian). Order Number DE91624913. Source: OSTI; NTIS (US Sales Only); INIS.

A low-temperature irradiation channel to study superconducting current-carrying elements and structural materials under conditions of irradiation by neutrons and gamma-quanta in the fast neutron source of the FAKEL electron linac at a joint action of mechanical, current and magnetic loads is considered. A maximum thermal power compensated by a cryogenic system at a level of 4.5-5 K comes up to 250W at a fast neutron flux $\simeq 8.5 \times 10^{12}$ neutr./cm^2 at energy $E_n \geq 0.1$ MeV. A cooling of samples studied is accomplished by a helium coolant liquefied in a condenser. A scheme for cooling samples by helium at a temperature $\simeq 1.6$ K is also given. 11 refs.; 8 figs.; 2 tabs.

15115 (IFVE-OEA-OP-OKU-89-128) **The N8 channel beam loss monitor system.** Afonin, A.G. (and others); Galyaev, N.A.; Davydenko, Yu.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 10p. (In Russian). Order Number DE91625891. Source: OSTI; NTIS (US Sales Only); INIS.

High intensity 70 GeV proton beam loss monitor system architecture in the area of single beam pass is described. The main system components choosing as detectors recording and controlling electronics are grounded on. There are list of the main system monitoring tasks and some experimental results. 12 refs.; 6 figs.

15116 (IFVE-OKU-89-168) **System of synchronization with the magnetic field of a booster synchrotron.** Bruk, V.L.; Korolev, Yu.V.; Stolyarov, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 11p. (In Russian). Order Number DE91624878. Source: OSTI; NTIS (US Sales Only); INIS.

A description of the system for synchronization with the magnetic field at the booster synchrotron is given. It works with a 1.5 Gs step within the field range from 1000 to 12160 Gs and the field rate within 0-600 kGs/s. The accuracy is better then $\pm 2 \times 10^{-4}$. 8 refs.; 4 figs.

15117 (IFVE-ONF-89-82) **Mathematical simulation of the calorimetric detector magnetic system.** Zakamskaya, L.T.; Kozlovskij, E.A.; Tkachenko, N.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 19p. (In Russian). Order Number DE91624914. Source: OSTI; NTIS (US Sales Only); INIS.

Mathematical simulation of magnetic fields in the universal calorimetric detector of accelerating and storage facility is carried out. It is shown that for the main magnetic system variants magnetic field intensity of 1.55-1.68 T may be obtained at the current linear density in solenoid winding and correcting coils of 13.5 kA/cm. However the field uniformity of less than 1% is attained only when using both correcting coil and ferromagnetic insertion. Comparison of considered variants shows that correcting coil has much more effect on magnetic induction value than ferromagnetic insertion. 8 refs.; 7 figs.; 2 tabs.

15118 (IFVE-OP-89-77) **70 GeV proton beam splitting with a bent single crystal.** Bavizhev, M.D.; Galyaev, N.A.; Gres', V.N.; Dudenko, V.V.; Zapol'skij, V.N.; Kotov, V.I.; Rzaev, R.A.; Chesnokov, Yu.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 11p. (In Russian). Order Number DE91624916. Source: OSTI; NTIS (US Sales Only); INIS.

The splitting of a 70 GeV proton beam at the angle of 60 mrad has been realized with the help of silicon and germanium crystals approx. 60 mm long. A possibility to use the obtained beams for carrying out two experiments simultaneously has been shown. The beam deflection efficiency is 5×10^{-5}. 9 refs.; 7 figs.

15119 (IFVE-OP-89-188) **Possibilities of beam monitoring with TV technique using optimal radiation from a flying wire scanner.** Novikov, V.P.; Serga, E.V.; Kharlamov, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 15p. (In Russian). Order Number DE91624915. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to NIM.

A new technique for beam diagnostics using a radiation arising from charged particle interaction with a wire crossing the beam is proposed. Possibilities of using optimal transition radiation are considered. The possibilities of using this technique for the IHEP UNK, CERN, FNAL and KhFTI accelerators are estimated. 11 refs.; 6 figs.; 2 tabs.

15120 (IFVE-OP-89-191) **Perspectives of using bent single crystals for particle beam shaping in the UNK experimental area.** Galyaev, N.A.; Garkusha, V.I.; Zapol'skij, V.N.; Kartashev, V.P.; Kotov, V.I.; Novoskol'tsev, F.N.; Pzaev, R.A.; Chesnokov, Yu.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 8p. (In Russian). Order Number DE91624873. Source: OSTI; NTIS (US Sales Only); INIS.

A possibility of using bent single crystals at the UNK in the TeV-energy region is shown. Defenite proposals on using crystal deflectors at the UNK beam lines are represented. 8 refs.; 7 figs.

15121 (IFVE-OUNK-89-187) **Study on superconducting dipole magnet for the UNK.** Ageev, A.I. (and others); Andreev, N.I.; Balbekov, V.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 12p. (In Russian). Order Number DE91624879. Source: OSTI; NTIS (US Sales Only); INIS.

This paper presents the results on the study of training effects, mechanical stability, ac losses, static heat leaks, ramp rate characteristics and coil heating during a quench of a superconducting dipole magnet for the UNK. The measurements of the transfer function and of bore field nonlinearities are also presented. The effect of iron shield saturation, of magnetization of the current-carrying element and collars on the bore field quality is considered. 6 refs.; 6 figs.; 4 tabs.

15122 (IFVE-OUNK–89-189) **Air break through into a long vacuum chamber.** Gubrienko, K.I.; Zakharov, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 10p. (In Russian). Order Number DE91624917. Source: OSTI; NTIS (US Sales Only); INIS.

The velocity of the air propagation in a long vacuum chamber under break-through conditions is estimated on the basis of carried out investigations. The character of pressure changes in various chamber cross sections is also determined. In the channels of proton beam extraction from accelerating and storage complex vaccuum chamber has a partition with minimum thickness and bearing atmospheric pressure. In case of partition failure or break of some other chamber section there is a risk of the accelerator vacuum system filling with atmospheric air. 5 refs.; 7 figs.; 2 tabs.

15123 (INS-T–499) **Development of new data acquisition system at the SF cyclotron facility.** Yoshimura, Katsumi (Tokyo Inst. of Tech. (Japan). Faculty of Science); Yoshida, Atsushi; Toriyama, Tamotsu; Nagai, Yasuki; Omata, Kazuo; Kubono, Shigeru. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Oct 1990. 49p. (In Japanese). Order Number DE91767866. Source: OSTI; NTIS (US Sales Only); INIS.

A new data acquisition system has been developed for experiments at the SF cyclotron facility of the Institute for Nuclear Study of the University of Tokyo with using VAX Station 3500. This system includes CAMAC together with J-11 as a front-end processor, and is intended to be used in event-by-event mode data acquisition. An explanation of the basic structure of the system and detailed instructions are given for the practical usage. (author).

15124 (Juel–2402) **Spectrometric determination of the species distribution of hydrogen and deuterium in the multi-megawatt ion sources (PINI) of the neutral beam injectors NI-1 and NI-2 of TEXTOR.** Rotter, H.; Uhlemann, R. Forschungszentrum Juelich GmbH (Germany, F.R.). Inst. fuer Plasmaphysik. Nov 1990. 97p. (In German). Order Number DE91769003. Source: OSTI; NTIS (US Sales Only); INIS.

The ion species fractions of hydrogen H^+, H_2^+, H_3^+ and deuterium D^+, D_2^+, D_3^+ in the extracted beam of the multi-megawatt ion sources (PINI) of the neutral beam injectors of TEXTOR are determined. The measurements are obtained from two grating spectrometers of 0.5 m focal length with a light guiding system of 50 mm aperture using the Doppler shifted H_α/D_α-light of the accelerated beam particles. The spectral resolution obtained is 0.76 A with a 50 μm entrance slit. The ion source is a bucket source (modified JET PINI) with a multipole magnetic field in checkerboard arrangement. The species fraction measurements are performed as function of beam current, ion source pressure and beam pulse length. The results for hydrogen and deuterium at particle energies of 20-55 keV and beam currents of 13-87 A show no significant difference between neutral injector I and II. For 55 keV and a beam current of 87 A in hydrogen and 63 A in deuterium a species mix of 67.2:24.5:8.4% (H^+:H_2^+:H_3^+) and of 69.1:23.8:7.1% (D^+:D_2^+:D_3^+) is obtained. (orig.).

15125 (KEK–90-3) **High-power klystron simulations using FCI - field charge interaction code.** Shintake, Tsumoru. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). May 1990. 51p. Order Number DE91768091. Source: OSTI; NTIS (US Sales Only); INIS.

FCI-code is 2-1/2 dimensional particle-in-cell simulation program dedicated to analyze and design high-power klystron amplifiers. In this report, outline of the code architecture is briefly described and how to execute the code will be explained in detail. (author).

15126 (KEK–90-5) **Precise timing signal transmission by a new optical fiber cable.** Tanaka, Shigeru (Sumitomo Electric Industries Ltd., Yokohama (Japan). Yokohama Lab.); Murakami, Yasunori; Sato, Yoshihiro; Urakawa, Junji. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). May 1990. 25p. Order Number DE91768093. Source: OSTI; NTIS (US Sales Only); INIS.

For the precise timing signal transmission, a new optical fiber cable system was developed and installed between the 2.5GeV LINAC gun room and the TRISTAN control room. This fiber cable showed the reduced thermal transmission delay change less than 10psec/km in the temperature range from -20 to 30degC (average 0.04ppm/degC), which is 100 times smaller than that of any other existing coaxial cables and conventional optical fiber cables. The developed optical to electrical (O/E) and electrical to optical (E/O) converters also achieved the timing accuracy within 11psec over the temperature range from 10 to 35degC. The installed cable system in KEK eliminated the necessity of adjusting the phase drift of the TRISTAN Accumulation Ring (AR) RF signal (508MHz), which was required with the former coaxial cable due to the temperature change in a year. Measured full width of jitter over the installed 1600m fiber link was 18.8psec. (author).

15127 (KFK–4432) **A collector testbench for electron coolers.** Woertge, M. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Kernphysik. Jun 1988. 80p. (In German). Order Number DE91764706. Source: OSTI; NTIS (US Sales Only); INIS.

A new collector design for electron coolers was elaborated in the Karlsruhe electron cooling group at LEAR (CERN). For testing the performance of the collector a linear set-up was built with an electron beam of energies up to 20 keV and currents up to 1.25 A. In the present stage maximum collector perveance of 37 $\mu AV^{-3/2}$ can be obtained. Loss rates are well in the 10^{-5} region for collector perveances of ≤ 25 $\mu AV^{-3/2}$. The collector was investigated in detail and a new type of computerized control and monitor system was tested based on a Macintosh Plus personal computer with a special interface for CAMAC and VME. (orig.).

15128 (KFK–4474) **Design of a fast electron beam scanning system for compact synchrotron light sources.** Moser, H.O. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Kernverfahrenstechnik); Lehr, H. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Kernverfahrenstechnik. Oct 1988. 24p. Order Number DE91764705. Source: OSTI; NTIS (US Sales Only); INIS.

The design of an electron beam scanning system for compact storage ring synchrotron light sources is described. The main features are a scan frequency of 100 Hz and an angular amplitude of ± 5 mrad. Two different configurations of scan dipoles allow to confine the scan to one cell using 4 dipoles or to repeat the scan periodically in each bending magnet by means of 2 scan dipoles per cell. Combinations of these basic configurations are possible. The location of the node of the pivoting electron beam can be optimized with respect to the maximum scan angle by slightly unbalancing the field strength in different scan dipoles. The scan dipoles are H-shaped magnets made from laminated iron. Their gap width is 68 mm. They are powered by fast transistor-bridge power supplies which are controlled by freely programmable function generators capable to realize a triangular current waveform with a deviation of less than 0.1% except for a 1% neighbourhood of the apex. Estimates of the influence of the scanning on both quantum and Coulomb lifetime indicate acceptable lifetime reductions provided the minimum distance between distorted closed orbit and aperture exceeds about 6 standard deviations of the spatial electron distribution. (orig.).

15129 (LAL-RT–9011) **Use of Priam in cathode design.** Le Meur, G. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Jun 1990. 16p. (CONF-9006242–: Workshop on short pulse high current cathodes, Bendor (France), 18-22 Jun 1990). Order Number DE91767810. Source: OSTI; NTIS (US Sales Only).

After a brief review of the mathematical formulations of the particle code PRIAM, examples of its possibilities in cathode simulations are given.

15130 (LA-UR–91-1110) **A new approach in simulating RF linacs using a general, real-time signal processor.** Young, A.; Jachim, S.P. Los Alamos National Lab., NM (USA). [1991]. 4p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910505–3: Particle accelerator conference, San Francisco, CA (USA), 6-9 May 1991). Order Number DE91009974. Source: OSTI; NTIS; INIS; GPO Dep.

Strict requirements on the tolerances of the amplitude and phase of the radio frequency (RF) cavity field have recently been necessary to advance the field of accelerator technology. Due to these stringent requirements of modern accelerators a new approach of

modeling and simulating is essential in developing and understanding their characteristics. This paper describes the implementation of a general, linear model of an RF cavity which is used to develop a real-time signal processor. This device fully emulates the response of an RF cavity upon receiving characteristic parameters (Q_0, ω_0, $\delta\omega$, R_S, ζ_0). Simulating an RF cavity with real-time signal processor is beneficial to accelerator designers because the device allows one to answer fundamental questions on the response of the cavity to a particular stimulus without running the accelerator. In particular, the complex interactions between the RF power and the control systems, the beam and cavity fields can simply be observed in a real-time domain. The signal processor can also be used upon initialization of the accelerator as a diagnostic device and as a dummy load for determining the closed loop error of the system. In essence, the signal processor is capable of determining whether the control systems and peripheral devices are operating properly without going through the tedious procedure of running beam through a cavity.

15131 (LBL–29345) **Magnet cable manufacturing.** Royet, J. Lawrence Berkeley Lab., CA (USA). Oct 1990. 64p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010210. Source: OSTI; NTIS; GPO Dep.

The cable is the heart of a superconducting accelerator magnet. Since the initial development of the Rutherford Cable more than twenty years ago, many improvements in manufacturing techniques have increased the current carrying capacity. When the Tevatron cable was specified fifteen years ago the current carrying capacity was 1800 A/mm^2 at a field of 5.3T. During the intervening years it has been increased to 3000 A/mm^2. These improvements were due to refinements in the fabrication of the strands and the formation of the cable from the strands. The metallurgists were able to impart significant gains in performance by improving the homogeneity of the conductor. The engineers and technicians who designed and built the modern cabling machines made an enormous contribution by significantly reducing the degradation of wire performance that occurs when the wire was cabled. The fact that these gains were made while increasing the speed of cabling is one of the technological advances that made accelerators like the SSC possible. This article describes the cabling machines that were built to manufacture the cable for the full scale SSC prototype magnets and the low beta quadrupoles for the Fermilab Tevatron. This article also presents a compendium of the knowledge that was gained in the struggle to make high performance cable to exacting dimensional standards and at the throughput needed for the SSC. The material is an important part of the technology transfer from the Department of energy Laboratories to Industry.

15132 (LBL-PUB–680/3-91) **Putting synchrotron radiation to work: New opportunities for industrial R&D.** Lawrence Berkeley Lab., CA (USA). Mar 1991. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91009880. Source: OSTI; NTIS; INIS; GPO Dep.

This paper describes the basic categories of experimental techniques that have been successfully exploited at existing synchrotron facilities or, in some cases, that are expected to join the research armamentarium at the next-generation synchrotron sources now under construction, such as the ALS. In each case, a selection of typical industrial applications is noted.

15133 (NIIEFA-P-A–0795) **Experimental simulation of vacuum channel elements of the accelerating-storage complex.** Ershov, B.D.; Ivanov, V.V.; Ryabov, V.V.; Saksaganskij, G.L.; Filippov, A.A. Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR). 1989. 26p. (In Russian). Order Number DE91624882. Source: OSTI; NTIS (US Sales Only); INIS.

Results of experiments on kinetics of vacuum treatment of vacuum channel elements under primary evacuation directly after assemblying and under evacuation after chamber wall surface treatment with glow discharge plasma in argon taking account of various possible operational conditions, those on determination of desorption characteristics of structural materials and residual gas partial composition as well as on simulation of integrated vacuum channel with integral cryopumps are presented. On the basis of obtained experimental data mean gas pressure in the chamber with a beam is calculated. The results of experimental and theoretical investigations verified the validity of accepted design solutions. 11 refs.; 11 figs.; 7 tabs.

15134 (NIIYaF-MGU–89-36-113) **Induction charging device for the MGU NIIYaF electrostatic accelerator.** Almazov, A.V.; Dzagurov, O.B.; Krivolap, V.V.; Sirotinin, E.I. Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1989. 21p. (In Russian). Order Number DE91624883. Source: OSTI; NTIS (US Sales Only); INIS.

Operation principle for induction-type charging device set on the MGU NIIYaF electrostatic accelerator is presented. Design of units is described and main parameters of induction charging device (ICD) are given. Comparison of ICD with foreign charging devices of induction-type allows to speak about certain advantages of ICD. Current transfered by ICD transport unit is higher by several times than that of pelletron. ICD transport unit is comparable with laddetron according to value of transfered current. Weight of length unit of ICD transport part is however by 2-3 times less than that of laddetron. 6 refs.; 9 figs.

15135 (ORNL/TR–91/4) **Shielding design methods of a synchrotron radiation facility: Part 1, Accelerator.** Ban, Syuichi (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)); Hirayama, Hideo. Oak Ridge National Lab., TN (USA). Apr 1991. 45p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010722. Source: OSTI; NTIS; INIS; GPO Dep.

Various problems for designing the shield of a synchrotron radiation facility are summarized and discussed. The characteristics of the radiation fields and of the administration of radiation protection around the faciiity are also presented. 60 refs., 6 figs., 10 tabs.

15136 (SSCL–320) **The SSC dipole: Its conceptual origin and early design history.** Dahl, P.F. Superconducting Super Collider Lab., Dallas, TX (USA). Jun 1990. 37p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-89ER40486. Order Number DE91009984. Source: OSTI; NTIS; INIS; GPO Dep.

The magnet system for the Superconducting Super Collider will likely remain the most ambitious – and challenging – application of superconducting technology for the foreseeable future. The centerpiece of the system is the behemoth collider dipole magnet. Its design, still evolving in its detailed features, dates from the mid-1980's when it emerged as the winner in an early technical showdown that occupied the fledgling SSC project. However, some of its gross features can be traced back to three path-breaking superconducting accelerator initiatives under way a decade earlier – on the East Coast, on the West Coast, and in the Midwest. Other features have a still earlier legacy. In the present report we chronicle the origins and chief milestones in the development of certain SSC dipole design concepts. Unfortunately, the chronicle must remain incomplete, with the design not yet frozen as we go to press and still subject to important modifications as the SSC Laboratory settles in near its future home in Ellis County, Texas, hard on the heels of a wide-ranging design review in the closing days of the SSC Central Design Group in (CDG) Berkeley. Be that as it may, in what follows we concentrate on the early years in an attempt to recapitulate the birth of the dipole, taking as our point of departure the SSC Reference Designs Study (RDS) of 1984. In Section 3 we touch on the background for the various RDS options, including ISABELLE/CBA and the Tevatron. In Section 4 the narrative focuses on the two final protagonists, a high-field cosine theta (cos θ) magnet and a low-field superferric magnet. Section 5 recounts the circumstances surrounding the selection of a particular magnet "style" for further development, and the ups and downs of the first model magnets. We conclude with a smattering of progress highlights in refining the design during the final push under the reign of the CDG.

15137 (SSCL–343) **A controlled master frequency oscillator for the SSC low energy booster.** Mestha, L.K. Superconducting Super Collider Lab., Dallas, TX (USA). Jan 1991. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-89ER40486. Order Number DE91011004. Source: OSTI; NTIS; INIS; GPO Dep.

A variable frequency oscillator is normally used to generate the master frequency for an accelerator. For the Low Energy Booster (LEB) at the Superconducting Super Collider (SSC) the prospects of using a Direct Digital Synthesizer (DDS) to vary the frequency from 47 MHz to 59 MHz are considered. A Digital Signal Processor (DSP) which can be loaded with the desired frequency values is interfaced to the DDS. These values are launched on the DDS at known intervals to ramp the frequency smoothly. In this paper the observations made while ramping the frequency are discussed. The design principle of the digital synchronization of the LEB frequency source with the Medium Energy Booster (MEB) frequency source is also briefly discussed. When developed, such a system can be used to synchronize the two machines. 23 refs., 10 figs.

15138 (SSCL–372) **Conceptual design for the thermal shield bridges and multilayer insulation in the interconnect region for the SSC.** Baritchi, D. (Superconducting Super Collider Lab., Dallas, TX (USA)); Nicol, T.; Boroski, W. Superconducting Super Collider Lab., Dallas, TX (USA); Fermi National Accelerator Lab., Batavia, IL (USA). Mar 1991. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-89ER40486 ;AC02-76CH03000. (FNAL/C–91/79;CONF-910340–2: International industrial symposium on the super collider, Atlanta, GA (USA), 13-15 Mar 1991). Order Number DE91010315. Source: OSTI; NTIS; GPO Dep.

The interconnect region serves as the connection area between magnets. In order to minimize radiant heat transfer in the interconnect area, we use shield bridges which span the 80K and 20K shield gap between adjacent magnets. A sliding joint between bridge sections on adjacent magnets accommodates contraction during cool-down. An investigation was done to determine which attachment schemes (riveted or bolted versus welded) are better for heat transfer. Each shield bridge is covered with the same multilayer insulation scheme used throughout the body of the magnet. These shield bridges also contain pressure reliefs for each shield in the event of an internal piping failure. The reliefs are located in the upper half of the shield section in order to prevent liquid spills from impinging directly onto the vacuum vessel wall. 7 refs., 7 figs., 3 tabs.

15139 (SSCL–374) **Design and A.C. loss considerations for the 60 mm dipole magnet in the high energy booster.** Snitchler, G.; Jayakumar, R.; Kovachev, V.; Orrell, D. Superconducting Super Collider Lab., Dallas, TX (USA). Apr 1991. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-89ER40486. (CONF-910340–1: International industrial symposium on the super collider, Atlanta, GA (USA), 13-15 Mar 1991). Order Number DE91010016. Source: OSTI; NTIS; INIS; GPO Dep.

The baseline design for the SSC High Energy Booster (HEB) has dipole bending magnets with a 50 mm aperture. A recent dynamic aperture study for the High Energy Booster (HEB) suggests that an increased aperture dipole magnet (DM) is desirable. Two cost neutral options for a 60 mm aperture HEBDM design are investigated. Field transfer function, field harmonics, and relative cost impact for these designs are presented. An analysis of the cryogenic heat and load due to A.C. losses generated in the HEB ramp cycle are also reported. Included in this analysis are losses from superconductor hysteresis, yoke hysteresis, strand eddy currents, and cable eddy currents. The A.C. loss impact of 2.5 μm vs. 6 μm filament conductor will be presented. Superconducting proximity effect is also considered for 2.5 μm filament conductors. 13 refs., 3 figs., 7 tabs.

15140 (UCRL-JC–106803) **Radiation from wigglers in the low energy ring of an asymmetric B factory.** Barletta, W.A. (Lawrence Livermore National Lab., CA (USA)). Lawrence Livermore National Lab., CA (USA). 21 Mar 1991. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910228–1: Meeting on rare and exclusive b and k decays, Santa Monica, CA (USA), 12-13 Feb 1991). Order Number DE91010474. Source: OSTI; NTIS; GPO Dep.

We compute the angular distribution of radiation in the near field of a long damping wiggler that is required to determine the equilibrium emittance and the damping decrement in the low energy ring of a high luminosity B factory. From the power distribution we can estimate the size of the vacuum chamber, the photon channel, and the photon dump that can tolerate the enormous average power of x-rays generated in the wiggler. 7 figs.

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Refer also to citation(s) 15091

15141 (ANL/CP–72471) **APS storage ring vacuum system.** Niemann, R.C.; Benaroya, R.; Choi, M.; Dortwegt, R.J.; Goeppner, G.A.; Gonczy, J.; Krieger, C.; Howell, J.; Nielsen, R.W.; Roop, B.; Wehrle, R.B. Argonne National Lab., IL (USA). [1990]. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-901144–4: Vacuum design of advanced synchrotron light sources, Argonne, IL (USA), 13-15 Nov 1990). Order Number DE91010757. Source: OSTI; NTIS; INIS; GPO Dep.

The Advanced Photon Source synchrotron radiation facility, under construction at the Argonne National Laboratory, incorporates a large ring for the storage of 7 GeV positrons for the generation of photon beams for the facility's experimental program. The Storage Ring's 1104 m circumference is divided into 40 functional sectors. The sectors include vacuum, beam transport, control, acceleration and insertion device components. The vacuum system, which is designed to operate at a pressure of 1 n Torr, consists of 240 connected sections, the majority of which are fabricated from an aluminum alloy extrusion. The sections are equipped with distributed NeG pumping, photon absorbers with lumped pumping, beam position monitors, vacuum diagnostics and valving. The details of the vacuum system design, selected results of the development program and general construction plans are presented. 11 refs., 6 figs., 3 tabs.

15142 (ANL/CP–72484) **APS Storage Ring vacuum chamber fabrication.** Goeppner, G.A. Argonne National Lab., IL (USA). [1990]. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-901144–5: Vacuum design of advanced synchrotron light sources, Argonne, IL (USA), 13-15 Nov 1990). Order Number DE91010818. Source: OSTI; NTIS; INIS; GPO Dep.

The 1104-m circumference Advanced Photon Source Storage Ring Vacuum System is composed of 240 individual sections, which are fabricated from a combination of aluminum extrusions and machined components. The vacuum chambers will have 3800 weld joints, each subject to strict vacuum requirements, as well as a variety of related design criteria. The vacuum criteria and chamber design are reviewed, including a discussion of the weld joint geometries. The critical fabrication process parameters for meeting the design requirements are discussed. The experiences of the prototype chamber fabrication program are presented. Finally, the required facilities preparation for construction activity is briefly described. 6 refs., 6 figs., 1 tab.

15143 (ANL/CP–72575) **Analysis of the beam position measurement with button-type pickups in APS.** Chung, Y. Argonne National Lab., IL (USA). [1990]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-9010267–4: 1990 workshop on accelerator instrumentation, Batavia, IL (USA), 1-4 Oct 1990). Order Number DE91010819. Source: OSTI; NTIS; INIS; GPO Dep.

The response of electrostatic button-type pickups for the measurement of the transverse position of charged particle beams was investigated and analytic formulae were obtained for the signal as a function of time t. The study was done for beam pipes of circular and elliptic cross sections, for rectangular and nonrectangular electrodes, and for several cases of longitudinal beam profiles. In particular, the error in the measurement of the beam position using circular electrodes as compared to rectangular ones was found to be less than 100 μm per 1 cm of beam excursion from the center of the beam pipe for the case of APS. 3 refs., 4 figs., 1 tab.

15144 (ANL/CP–72656) **Computation of a quadrupole magnet for the APS storage ring.** Turner, L.R.; Kim, S.H.; Thompson, K.M. Argonne National Lab., IL (USA). [1990]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-9010105–2: 4. biennial IEEE conference on electromagnetic field computation, Toronto (Canada), 22-24 Oct 1990). Order Number DE91010815. Source: OSTI; NTIS; INIS; GPO Dep.

The storage ring of the Advanced Photon Source will include 400 quadrupole magnets for focusing the beam. A prototype quadrupole has been designed, constructed, and measured. This paper describes the two- and three-dimensional (2-D and 3-D) field computations performed for this design. 2 refs., 6 figs., 1 tab.

15145 (CERN–90-10(v.3)) **Large hadron collider workshop. Proceedings. Vol. 3.** Jarlskog, G.; Rein, D. (eds.). European Organization for Nuclear Research, Geneva (Switzerland); European Committee for Future Accelerators. 3 Dec 1990. 857p. (CONF-9010291–: Large Hadron Collider (LHC) workshop: physics and instrumentation, Aachen (Germany, F.R.), 4-9 Oct 1990; ECFA–90-133(v.3).). Order Number DE91624934. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of the LHC workshop at Aachen was to discuss the 'discovery potential' of a high-luminosity hadron collider (the Large Hadron Collider) and to define the requirements of the detectors. Of central interest was whether a Higgs particle with mass below 1 TeV could be seen using detectors potentially available within a few years from now. Other topics included supersymmetry, heavy quarks, excited gauge bosons, and exotica in proton-proton collisions, as well as physics to be observed in electron-proton and heavy-ion collisions. A large part of the workshop was devoted to the discussion of instrumental and detector concepts, including simulation, signal processing, data acquisition, tracking, calorimetry, lepton identification and radiation hardness. The workshop began with parallel sessions of working groups on physics and instrumentaiton and continued, in the second half, with plenary talks giving overviews of the LHC project and the SSC, RHIC, and HERA programmes, summaries of the working groups, presentations from industry, and conclusions. Vol. 1 of these proceedings contains the papers presented at the plenary sessions, Vol. 2 the individual contributions to the physics sessions, and Vol. 3 those to the instrumentation sessions. (orig.).

15146 (IFVE-OUNK–89-163) **Longitudinal instability thresholds of counter-rotating pp-bar or ee-bar beams in a collider.** Ivanov, S.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 11p. Order Number DE91624935. Source: OSTI; NTIS (US Sales Only); INIS.

The longitudinal instability threshold for the multipole oscillations of two colliding beams is estimated; the beams are supposed to be counter-rotating in the same vacuum chamber. The eigenfrequencies of the usual bunch-to-bunch single beam oscillation modes are shown to be split into two sets due to beam-beam coupling through the resonance elements. The beam-beam coupling coefficient is found to depend upon the resonance element locations around the orbit with respect to the beam interaction points. 4 refs.

15147 (IFVE-OUNK–89-182) **Experimental study of the UNK superconducting dipole cooldown and warmup.** Ageev, A.I.; Bozhko, Yu.G.; Zhirnov, A.V.; Myznikov, K.P.; Sytnik, V.V.; Tarasov, A.V.; Shamichev, A.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 11p. (In Russian). Order Number DE91624936. Source: OSTI; NTIS (US Sales Only); INIS.

The results of the experimental investigations for cooldown to 4.5 K and warmup precesses in the single 6 m SC dipole magnet of the UNK with a cold iron are presented. The temperature distributions were measured with 232 temperature sensors arranged in 14 cross sections of the dipole. Both usual cryogenic technological processes and regimes connected with the SC magnet transition into a normal state were investigated. 3 refs.; 9 figs.

15148 (IFVE-OUNK–89-186) **Study on the current-carrying element of the UNK superconducting dipole magnet.** Bajdakov, A.N. (and others); Vasil'ev, V.A.; Vybornov, M.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 11p. (In Russian). Order Number DE91624937. Source: OSTI; NTIS (US Sales Only); INIS.

The current-carrying element of the superconducting (SC) dipole magnet for the IHEP accelerating and storage complex (UNK) is a flat Rutherford transposed cable consisting of 19 strands with 9 coated Sn+5%Ag alloy. The cable is manufactured from composite superconducting wires 0.85 mm in diameter each containing 8910 6 μm Nb-Ti filaments embedded into a copper matrix. The critical current density of the wire in the 5 T field at 4.2 K is at least 2.3×10^5 A/cm^2 which enables one to attain the bore field exceeding 6.4 T at a coil temperature of 4.25 K. The paper presents the results on the study of the basic parameters of the current-carrying element which determine the most important characteristics of superconducting magnets for the UNK. 9 refs.; 7 figs.; 3 tabs.

15149 (KFTI–89-6) **Calculation of electrodynamical characteristics and choice of accelerating structure for storage ring.** Karnaukhov, I.M. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Popkov, Yu.P.; Telegin, Yu.N.; Trushkin, N.A.; Dajkovskij, A.G.; Zakamskaya, L.T.; Ryabov, A.D. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1989. 9p. (In Russian). Order Number DE91624938. Source: OSTI; NTIS (US Sales Only); INIS.

Comparative analysis of several types of accelerating structures at standing E_{010} wave is conducted on the basis of numerical calculations performed with the use of the PRUD-0 and PRUD programs. Dispersion dependences of electromagnetic field distribution, quality and coupling impedance are calculated both for axially symmetric and axially asymmetric modes of oscillations in structures with 699.3 MHz operating frequency. It is shown that structure with a cell the form of which is optimized with respect to shunt resistance on the main mode possesses the numerical spurious impedance in higher modes. This is the main factor when choosing accelerating structure for storage ring with multi-bunch operation conditions. 12 refs.; 3 figs.; 3 tabs.

15150 (NIIEFA-P-A–0817) **Principles of designing and major parameters of a vacuum system of the NR-2000 storage-strecher facility.** Ershov, B.D. (and others); Kuz'min, E.G.; Saksaganskij, G.L. Nauchno-Issledovatel'skij Inst. Ehlektrofizicheskoj Apparatury, Leningrad (USSR). 1989. 22p. (In Russian). Order Number DE91624939. Source: OSTI; NTIS (US Sales Only); INIS.

Main parameters of the NR-2000 storage-stretcher facility, requirements to the vacuum system, synchrotron radiation characteristics, methods for calculating the vacuum system are presented. It is shown that to achieve average pressure of 1.3×10^{-7} Pa combined ion-getter pumps should be used for high-vacuum pumping of the facility. A brief description of the applied vacuum equipment, control and diagnostics system is presented. 15 refs.; 9 figs.

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4401 Radiation Instrumentation

Refer also to citation(s) 14347, 14590, 14608, 14947, 15052, 15073, 15078, 15106, 15132, 15145, 15522, 15532, 15533, 15535, 15539, 15540, 15542, 15544, 15547, 15635, 15651, 15685, 15780, 15782, 15800

15151 (ANL/CP–72394) **IPNS chopper spectrometer improvements.** Carpenter, J.M.; Loong, C.-K. Argonne National Lab., IL (USA). [1990]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-9010243–16: International collaboration on advanced neutron sources, Tsukuba (Japan), 21-26 Oct 1990). Order Number DE91010800. Source: OSTI; NTIS; INIS; GPO Dep.

We report the status of the IPNS chopper spectrometers and describe a number of projects underway and planned for their improvement. 6 figs.

15152 (ANL-HEP-CP–90-123) **Design and construction of the ZEUS barrel calorimeter.** Repond, J. Argonne National Lab., IL (USA). [1990]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-9010283–6: International conference on calorimetry in high energy physics, Batavia, IL (USA), 29 Oct 1990). Order Number DE91010615. Source: OSTI; NTIS; INIS; GPO Dep.

The mechanical design and construction techniques of the barrel calorimeter for the ZEUS detector are presented. The calorimeter

uses alternate layers of depleted uranium and scintillator with one radiation length sampling. The unit cell has e/h = 1 which yields an optimal energy resolution for hadronic jets. We discuss the placing of the structural components and cracks between modules. Details of the construction and assembly effort needed to realize the total calorimeter are reported. 4 figs., 1 tab.

15153 (BNL–46009) **The status of GALLEX.** Cribier, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). GALLEX Collaboration. Brookhaven National Lab., Upton, NY (USA). [1990]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-900822–31: 25. IUPAP international conference on high energy physics, Singapore (Singapore), 2-8 Aug 1990). Order Number DE91010371. Source: OSTI; NTIS; INIS; GPO Dep.

The present status of the Gallium Solar Neutrino Experiment performed by the GALLEX Collaboration in the Gran Sasso Underground Laboratory is described. The implementation phase of this experiment is now completed, the whole gallium is at hand and data taking starts now. After a short introduction and an outline of the basic experimental procedure, details will be given on different parts of the experiment and on some background. 14 refs., 2 figs.

15154 (BONN-IR–88-26) **Construction and calibration studies of the SAPHIR scintillation counters.** Kostrewa, D. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Mar 1988. 45p. (In German). Order Number DE91769179. Source: OSTI; NTIS (US Sales Only); INIS.

For the scintillation counter system of the SAPHIR detector at the stretcher ring ELSA in Bonn 50 time of flight counters and 12 trigger counters have been built. Each of them has two photomultipliers, one at each side. A laser calibration system with a pulsed nitrogen laser as central light source to monitor these photomultipliers has been optimized. It was used to adjust the photomultipliers and to test their long and short time instabilities. (orig.).

15155 (BONN-IR–89-56) **Simulation of light propagation in scintillation counters.** Thiele, P. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Dec 1989. 72p. (In German). Order Number DE91764822. Source: OSTI; NTIS (US Sales Only); INIS.

The properties of the scintillation counters of the SAPHIR detector have been simulated with a Monte Carlo programme. The calculated photomultiplier signals, the effective light velocity, the influence of the magnetic field on the photomultipliers, the time of flight resolution and the energy resolution of the counters could be compared with measured quantities. (orig.).

15156 (BONN-IR–90-06) **On-line program controlling the time-of-flight hodoscope of the SAPHIR detector.** Adscheid, R. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Feb 1990. 60p. (In German). Order Number DE91764713. Source: OSTI; NTIS (US Sales Only); INIS.

The TOF hodoscopes of the SAPHIR experiment consist of 124 photomultiplier tubes viewing 64 scintillation counters. To monitor the function and to calibrate each tube of this setup an online program was developped. Additionally a package of subroutines was programmed, to ease the handling of histograms under the special conditions of the online surrounding. (orig.).

15157 (BONN-IR–90-51) **The laser calibration of the ZEUS forward drift chambers: Studies of the electron drift in the inhomogeneous magnetic field.** Dobberstein, M.P. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Nov 1990. 141p. (In German). Order Number DE91764702. Source: OSTI; NTIS (US Sales Only); INIS.

The ZEUS detector at the electron proton collider HERA at DESY in Hamburg contains special particle tracking devices in the proton forward direction: The forward drift chambers. These drift chambers are located at the end of the detector solenoid in a high (up to 1.6 Tesla) and strongly inhomogeneous (maximum gradient 2-3 Tesla/m) magnetic field. We have studied the electron drift process inside the chambers (of special interest are the space drifttime relations required for the calibration) using both numerical and experimental methods: Numerically, we have investigated the electrostatic field inside the chambers with two and three dimensional finite difference codes and have calculated the drift times resp. space drifttime relations for arbitrary three dimensional configurations of the electric and magnetic fields. The influence of edge effects on gas amplification and drift times has also been considered. Experimentally, we have measured space drifttime relations representatively distributed over the forward drift chambers using a laser calibration system developed for this purpose. These measurements agree with the calculations at low magnetic fields but deviate at fields higher than 0.8 Tesla; the deviation reverses if one adds a small amount of ethanol to the chamber gas argon/ethane (50/50). In addition, the numerical optimization of the operational voltages of the drift chambers has been successfully checked by measurements of the gas amplifications. (orig.).

15158 (BONN-IR–90-55) **Studies on the track reconstruction and on the accuracy of the track parameters in the OPAL jet chamber.** Roemer, U. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Nov 1990. 119p. (In German). Order Number DE91764703. Source: OSTI; NTIS (US Sales Only); INIS.

A comparison of the performance of pattern recognition programs for track reconstruction in the OPAL Jetchamber, Conformal Mapping and CHAIN, is presented. Using Monte Carlo events from the detector simulation program GOPAL, the efficiencies obtained and the track parameter resolutions are compared. It is shown that the influence of deviations from their nominal values of some calibration constants, - drift velocity, Lorentz angle and wire staggering, - on reconstructed tracks is small; deviations of about 2 σ affect both efficiency and momentum resolution by less than 0.1%. Tracks from the reaction $e^+e^- \rightarrow \mu^+\mu^-$ around 90 GeV have been used to compare the experimentally achieved track parameter resolutions with the Monte Carlo results. The best experimental resolution, $\sigma p_t/p_t$=8.8% from the CHAIN program, exhibits a not yet understood systematic error of about 6%. (orig.).

15159 (DESY–90-147) **The optimization of the electrostatic field inside the ZEUS forward drift chambers: Calculations and measurements.** Dobberstein, M.P. (Bonn Univ. (Germany, F.R.)); Krawczyk, F.; Schaefer-Jotter, M. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Nov 1990. 19p. Order Number DE91768986. Source: OSTI; NTIS (US Sales Only); INIS.

The electrostatic field inside small drift cells shows in general edge effects which are not negligible. These are usually corrected by field shaping wires or strips. The operating voltages of the field shaping electrodes have to be adjusted to maximize the field homogeneity. We present the underlying ideas of such an optimization procedure for the cells of the ZEUS forward drift chambers. Using the finite difference code PROFI, the optimization can be performed automatically by a multiple solution of the Poisson equation. An experimental verification of the optimal voltages was carried out measuring the gas amplifications at the six sense wires. Modifications of the drift cell geometry were necessary for calibration measurements with a laser beam. This caused additional distortions of the electrostatic field. Their influence was calculated using the MAFIA code, which allows to include open boundary conditions. (orig.).

15160 (DESY-FH1T–90-02) **Construction and test of the full-size prototype for the central jet chamber of the H1 detector.** Schernau, M. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik. Jul 1990. 65p. (In German). Order Number DE91768978. Source: OSTI; NTIS (US Sales Only); INIS.

In the framework of the H1 project for the central track chamber CJC a prototype with the full wire length of 2.31 m was built and taken into operation. This full-size prototype comprehends three complete cells of the internal jet chamber CJC 1. The construction of the cells equals thereby in all points to that of the CJC. By this a

chamber is available, by which important parameters like drift velocities, Lorentz angle, and position resolution can be determined before taking the CJC into operation. Furthermore reparatures can be first tried at the prototype. Besides the experiences obtained in the erection of the prototype and the taking of the chamber into operation help in the corresponding working steps of the CJC. The dependence of the position resolution on the position of the track in the detector was studied for the gas mixture $Ar/CO_2/CH_4$ in the mixing ratio 89/10/1. For this several measurement series were taken up, in which the distance of the track from the signal-wire plane, the angle α between the track and the signal-wire plane, and the angel θ between track and longitudinal detector axis were varied. At a drift path of 10 mm in cell 2 a resolution of 160 μm was reached, which increases for larger drift pathes because of the increasing of diffusion. For cell 1 however only a value of 180 μm was reached. The determination of the position resolution in dependence on the track angle showed that the best values for the resolution were aimed at tracks, which run parallel to the signal-wire plane. (orig./HSI).

15161 (DESY-FH1T-90-04) **Construction and test of a drift-chamber track trigger for the central track chamber of the H1 detector.** Gellrich, A. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.); Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Experimentalphysik. Nov 1990. 95p. (In German). Order Number DE91764622. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes the planning, the building and the testing of a trigger system for the central jet chamber (CJC) of the H 1-experiment at HERA. The purpose of the system is to provide a single particle trigger in the test phase of the H 1-experiment based on the signals of the CJC only. A trigger signal is generated for cosmic ray tracks crossing the vertex region similar to tracks of the ep-interactions at HERA. The track definition is provided by a coincidence of a number of signals (majority) belonging to the sense wires of adjacent cells. Due to the delayed occurence of the signals (finite drift velocity) they have to be expanded to the maximal drift time of around 1 μs. Since the CJC was not available for testing the trigger, the drift chamber trigger electronics was adapted first to the conditions of a full-size-prototype (FSP) of the CJC. In test runs with cosmic radiation the adjustable parameters for track definition and noise suppression were optimized. The important performance quantities were measured: The trigger efficiency using a scintillator trigger system as a reference was (98.5±2.2)%. From a scan (92±10)% of the triggered events were determined to have reconstructable tracks. The trigger rate for cosmic rays was 62 Hz. As a result of this work a concept for a CJC-trigger electronics was developed. (orig./HSI).

15162 (ECN-RX-90-056) **Experiences with the reaction ^{93}Nb(n,n')^{93m}Nb in neutron fluence monitoring.** Freudenreich, W.E. (Netherlands Energy Research Foundation, Petten (Netherlands)). Netherlands Energy Research Foundation, Petten (Netherlands). Aug 1990. 10p. (CONF-900814--: 7. ASTM-EURATOM symposium on reactor dosimetry, Strasbourg (France), 27-31 Aug 1990). Order Number DE91626029. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted for publication.

Some facts are presented why niobium is of interest in neutron fluence monitoring. A description is given of the procedure that was followed with the niobium monitors.The results obtained wit this procedure are good with respect to the statistical uncertainties in the ^{93m}Nb-activity (about 2.5 percent relative standard deviation). Systematic effects are somewhat larger. One of the systematic effects present in the ratio of the measured specific reaction rates (spectrum index SI) of the reactions ^{93}Nb(n,n')^{93m}Nb and ^{54}Fe(n,p)^{54}Mn could be identified: the dependence of the SI (Nb/Fe) from the irradiation position in the reaction core (which is qualitatively in good agreement with other observations). However, the distributions of the SI (Nb/Fe) still show that other systematic effects must be present. Up to now it is not known whether they are due to the measurement procedure or to the irradiation procedure in the reactor. (author). 3 refs.; 5 figs.; 2 tabs.

15163 (IFVE-ONF-89-98) **Dark current and photocurrent noises in the $3x10^{-3}$-$3x10^{-1}$ Hz frequency range.** Kurchaninov, L.L.; Sushkov, V.V.; Shuvalov, R.S. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 8p. (In Russian). Order Number DE91626074. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to the journal Prib. Tekh. Ehksp.

The dark current spectral density of photomultipliers FEhU-140, FEhU-85, FEhU-87 in the photodiode arrangement is shown to be of 1/f character. The instantaneous fluctuations of the dark current and photocurrent in FEhU-140 in the frequency range where flicker noise is dominating are found to be far from Gaussian ones. They are Gaussian ones in the higher frequency range, but with the dispersion differing from the Poisson flux of electrons. 13 refs.; 4 figs.; 1 tab.

15164 (IFVE-ORI-ONF-OEIUNK-89-221) **Choice of muon spectrometer configuration for collider experiments.** Babintsev, V.V.; Lanev, A.V.; Mokhov, N.V.; Striganov, S.I.; Uzunyan, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 42p. (In Russian). Order Number DE91626063. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to NIM.

Requirements to the muon spectrometers (MS) were considered on an example of UNK facility for the experiments at the universal calorimetric detector (UCD) at the energy $\sqrt{s}$=6 TeV. Factors determining the momentum resolution were analyzed and expressions for momentum resolution of various MS configurations are presented. Background rates at various detector depths were estimated. On this basis the UCD MS configuration and parameters were recommended. 15 refs.; 17 figs.; 4 tabs.

15165 (INIS-SU-231, pp. 156-166) **Radiation coding as a high-efficient method for recording information on radioisotope distribution in a body.** Gorbunov, S.V.; Dyatlov, V.Ya.; Digtyar', V.A.; Isakov, L.M.; Tolchenov, E.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143--: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Different designs of personnel spectrometers, recording information on radionuclide distribution in a human boby, are considered. a conclusion is made that the most promising is use of coding devices as multipinholes collimators of medical gamma chamber. 26 refs.; 8 figs.

15166 (INIS-SU-231, pp. 138-140) **Large-area flow gas-discharge counter for radiometric devices.** Glazunov, S.V.; Isakov, L.M.; Lebedev, O.A.; Sakseev, E.K.; Shadrin, A.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143--: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

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PDLS-01P flow gas-discharge counter with 900 cm^2 area of the window efficient surface for radiometers is described. The working gas is argon (90%) and flow rate under normal atmospheric conditions is 100 ml/min. The counter detection efficiency from dry sources with 1 cm^2 active apot in 2π-geometry is 70% for ^{239}Pu and ^{4}C and for ^{90}Sr+^{90}Y. The counter may be also used for mesuring the volume activity of liquids, aerosols and gases, including measuring of tritium and carbon content in air under intensive γ backgroundradiation of noble gases. Installation of three counters one above the other permits simultaneous measurement of Bf and dt radiations and estimation of the counters background under varying radiation conditions.

15167 (INIS-SU-231, pp. 140-143) **Measuring volume activity of a liquid by means of the RZhS-05 radiometer.** Andreeva,

M.M.; Bykovskij, N.N.; Digtyar', V.A.; Isakov, L.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

The design of The RZhS-05 universal radiometer permitting to measure volume activity of liquids and gases by α and β radiations in the 0.05-3.5 MeV energy range is described. The sample preparation and measurement take not more than 10 min. The measurements error for solutions with unknown isotopic composition is not over ±30%. In radiometer 3 types detection are used: the developed surface detector on scintillating polystyrene film basis for βdecay nuclide mesurement; sorbent-scintillator on the basis of zinc sulphide with tin hylroxide for α nuclide measurement and liquid scintillator for low-energy nuclide measurement.

15168 (INIS-SU–231, pp. 143-145) **Use of the RZhS-05 radiometer for measuring the volume activity of gases.** Bykovskij, N.N.; Isakov, L.M.; Sakseev, E.K.; Andreeva, M.M.; Digtyar', V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

The design of a detection unit on scintillation polystyrene film basis, with the total area of about 10000 cm'2, developed for monitoring of tritium and inert radioactive gas content in air is described. Thhe detection unit sensitivity is $2.1x10^{-4}$; $1.2x10^{-4}$ and $1.4x10^{-4}$ $Bq^{-1}m^3xS^{-1}$ for tritium, ^{83}Kr and ^{133}Xe respectively. The proper radioactivity of the unit surrounded by 50 mm thick lead shielding constituted 1.8-2.2 s^{-1}.

15169 (INIS-SU–231, pp. 145-147) **Thermoexoemission detectors for monitoring radioactive contamination of industrial waste waters.** Obukhov, V.T.; Sobolev, I.A.; Khomchik, L.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Detectors on base of BeO(Na) monocrystals with thermoemission to be used for monitoring radioactive contamination of industrial waste waters are suggested. The detectors advantages are sensitivity to α and low-ehergy β radiations, high mechanical strength and wide range of measurements. The main disadvantage is the necessity of working in red light.

15170 (INIS-SU–231, pp. 149-152) **Radiometry of local contamination.** Ryabov, Yu.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

A mock-up of radiometer for monitoring surface contaminations of β decay radioactive nuclides on different configuration surfaces is developed and tested. The mock-up counting circuit permits to measure the detector unit pulse fluxes with the rate of $10\text{-}10^6$ pulses/min. Application of this circuit permitsti reduce the surface monitoring time by 2-3 times and to decrease the labour expenditures for decontamination by 50/0.

15171 (INIS-SU–231, pp. 154-156) **Radiometric device for measuring volume activity of tritium in aqueous samples.** Gorbunov, S.V.; Dyatlov, V.I.; Digtyar', V.A.; Isakov, L.M.; Tolchenov, E.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

A simple radiometric device on the basis of liquid scintillators for measuring volume activity of tritium in aqueous samples is developed. The device includes 2 photomultipliers with switch-on modules, lead shield for external radiation measurement dish, light reflector and data processing unit.If necessary scintillation film and granular base drtrctors may be used. 2 refs.; 1 fig.; 1 tab.

15172 (INIS-SU–240, pp. 73-75) **Threshold sensitivity of an X-ray image converter with microchannel plate to 1 MeV bremsstrahlung.** Vejs, M.Eh.; Knyazev, B.A.; Lebedev, S.V.; Simonov, V.P.; Fel'dman, G.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 75p. (In Russian). In *Thermonuclear synthesis: Scientific-technical collection.* Order Number DE91003079. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental study was made on sensitivity threshold of an X-ray image converter with microchannel plate as converting and amplifying element when film recording. Bremsstrahlung with 1 MeV energy, formed during absorption of relativistic electron beam in a target was used as X-radiation source. Experiments were conducted both with stationary beam with 1 mA current and with pulsed beam with 50 kA current. Threshold sensitivity was equal to several ten microjoules per square centimeter in the first case and about 1 $\mu J/cm^2$ in the second one. 9 refs.; 1 fig.

15173 (INP–1353/PS) **Proceedings of the Polish Moessbauer Community meeting, 8-10 October 1986, Cracow.** Kulgawczuk, D.S.; Ruebenbauer, K. (eds.). Institute of Nuclear Physics, Cracow (Poland). 1987. 196p. (CONF-8610476–: The Polish Moessbauer community meeting, Cracow (Poland), 8-10 Oct 1986). Order Number DE91626035. Source: OSTI; NTIS (US Sales Only); INIS.

Separate abstracts were prepared for 2 of the papers in this report. The remaining 26 papers, dealing with the use but not with advances in the use of Moessbauer effect in studies of solid state physics, were considered outside the subject scope of INIS. (M.F.W.).

15174 (KFK–4803) **Kinematically complete measurements of the break-up of ^{6}Li using the magnetic spectrograph 'Little John'.** Gsottschneider, G. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Kernphysik. Dec 1990. 66p. (In German). Order Number DE91764714. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes set-up and application of an extended detection system for the magnetic spectrograph 'Little John'. The set-up is used in experiments of the Coulomb induced break-up of ^{6}Li into α-particles and deuterons at the Karlsruhe Isochronous Cyclotron for the detection of both coincidence fragments. In first measurements the properties of the detection system are explored. It is shown that the extension provides an increased efficiency, simultaneously maintaining the angular resolution. This is achieved by a direct measurement of both particle trajectories and by an off-line subdivision of the solid angle acceptance. The differential cross sections obtained in this way are in a good agreement with known results and are completing the experimental information. (orig.).

15175 (LAL–9039) **Study of a gas filled detector for an experiment on double beta decay.** Dassie, D. (Bordeaux-1 Univ., 33 - Gradignan (FR)› Centre d'Etudes Nucleaires); Hubert, P.; Leccia, F.; Mennrath, P.; Longuemare, C.; Blum, D.; Busto, J.; Jullian,

S.; Lalanne, D.; Laplanche, F.; Szklarz, G.; Lamhamdi, D.; Linck, I.; Scheibling, F. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Jun 1990. 17p. (CONF-9006276--: 14. International Conference on neutrino physics and astrophysics, Neutrino 90, Cern (Switzerland), 10-15 Jun 1990). Order Number DE91767801. Source: OSTI; NTIS (US Sales Only).

A prototype detector built for background and shielding studies is described. The prototype is required in order to perform feasibility tests, to obtain data and criteria, for the construction of a large drift chamber. The external radioactive background and the one arising from the detector are evaluated. The background from a Mo thin plate is also estimated. The results show that the low radioactive materials used to build the detector are satisfactory.

15176 (LBL–30207) **Test beam results from the D0 endcap electromagnetic calorimeter module.** Spadafora, A.L. The D0 collaboration. Lawrence Berkeley Lab., CA (USA). Jan 1991. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-9010283–5: International conference on calorimetry in high energy physics, Batavia, IL (USA), 29 Oct 1990). Order Number DE91010245. Source: OSTI; NTIS; INIS; GPO Dep.

We have constructed the endcap electromagnetic modules of the D0 Uranium Liquid Argon Calorimeter. Details of the module design and construction are discussed and initial results from a test beam run with beam momenta ranging from 10–150 GeV/c are presented. We obtain an energy resolution with electron beams of $15.5\%/\sqrt{E(GeV)}$ with a small constant term of ~0.5% and a linearity of better than ±0.5%. 3 refs., 8 figs.

15177 (LIYaF–1403) **Double electron spectrometer.** Popeko, L.A.; Rudnev, Yu.P. AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki. 1988. 9p. (In Russian). Order Number DE91625013. Source: OSTI; NTIS (US Sales Only); INIS.

High-efficiency electron spectrometer with two superconducting and two Si(Li)-detectors has been developed for the investigation of single and coincidence electron spectra. The spectrometer contribution is well suited for measurements in beams of particles. 7 refs.; 2 figs.

15178 (LIYaF–1450) **Two-dimentional detector with high spatial resolution in two coordinates for X-ray diffractometry.** Andreev, V.A.; Krivshich, A.G.; Maleev, V.P.; Plakhtij, V.P.; Samsonov, V.M.; Stratilatov, A.B.; Shipunov, L.A. AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki. 1988. 14p. (In Russian). Order Number DE91625049. Source: OSTI; NTIS (US Sales Only); INIS.

The two-dimensional two-layer detector for the X-ray high-resolution diffractometer is described. It allows to detect 5.9 keV X-ray quanta in the full entrance window (200x200 mm) with equal accuracy $\sigma_x \simeq \sigma_y \leq 100$ μm. The diferential nonlinearity is smaller than 5% and integral nonlinearity is smaller than 3% in 6 mm from entrance window edge. 5 refs.; 8 figs.

15179 (LIYaF–1493) **Neutron dosemeters and radiometers check-up installation.** Konovalov, E.A.; Ploshchanskij, L.M.; Sajkov, Yu.P.; Fominykh, V.I. AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki. 1989. 14p. (In Russian). Order Number DE91626030. Source: OSTI; NTIS (US Sales Only); INIS.

Self-protecting installation UPND-1 for checking-up of neutron dosemeters and radiometers is developed for the operative check-up of the working devices by the equivalent field method and the reverse squares one. The installation is supplied by typical collimators for realization of the last method. When using the method of equivalent field the installation with fast neutron source of UBN-8-6 type ($2x10^7$ nxs^{-1}) allows a check-up of devices in the following ranges for radio-meter 'KRAN-1': fast neutrons 3.5-$1.25x10^4$cm^{-2}xs^{-1} intermediate neutrons 1.9-$4.6x10^3$cm^{-2}xs^{-1} thermal neutrons 1.8-$1.7x10^3$cm^{-2}xs^{-1}; for Dose-meter 'KDN-2' with the detecting unit 'BDMN-0.1': $0.16x10^{-2}$-1.25 Svxs^{-1} (0.16-$1.25x10^2$ remxc^{-1}). 12 refs.; 3 figs.; 2 tabs.

15180 (MLM–3680) **The dry heat exchange calorimeter.** Renz, D.P.; Wetzel, J.R.; Kasperski, P.W.; Duff, M.F. EG and G Mound Applied Technologies, Miamisburg, OH (USA). 25 Mar 1991. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-88DP43495. Order Number DE91010046. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A radiometric isothermal heat flow calorimeter that uses air instead of water as the heat exchange medium has been developed at Mound. The dry heat exchanger calorimeter is 42 in. high by 18 in. in diameter, making it extremely compact compared to existing units. The new system is ideally suited for transportable, stand-alone, or glovebox applications. Preliminary tests of the system have produced sample measurements with standard deviations less than 0.25% and sample errors less than 0.50%. These tests have shown that, except for very high precision measurements, the dry heat exchanger system will yield acceptance data with an accuracy comparable to those of Mound water bath systems now in use. 17 figs., 2 tabs.

15181 (NIIYaF-MGU–89-8-85) **Emulsion experiment for study on energy spectra of protons and nuclei of primary cosmic radiation in the energy range >10 TeV per particle.** Varkovitskaya, A.Ya.; Zamchalova, E.A.; Zatsepin, V.I.; Sazhina, G.P.; Sokol'skaya, N.V. Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1989. 37p. (In Russian). Order Number DE91625051. Source: OSTI; NTIS (US Sales Only); INIS.

Development of the emulsion chamber method to study the energy spectrum of protons and nuclei of primary cosmic radiation is described; the results obtained in long-term exposure of emulsion chambers in the stratospere are presented. 18 refs.; 20 figs.; 4 tabs.

15182 (NIIYaF-MGU–89-9-86) **Study on cosmic rays with the energy more than 1 TeV on satellites by means of the SOKOL detector.** Grigor'ev, N.L. Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1989. 40p. (In Russian). Order Number DE91625052. Source: OSTI; NTIS (US Sales Only); INIS.

The results of experiments in measuring the energy of charged particles and proton and helium nuclei charges in cosmic rays at 1 TeV energy and higher are presented. Purposes of experiments and ideas on which detector SOKOL is based are presented. The detector includes an ionization calorimeter with 80 scintillation detectors and thin radiators of the Cherenkov counters with light diffusion reflection. The Cherenkov counters give the possibility to separate reliably protons out of the whole cosmic rays flux not influencing particle reverse current into charge detectors. Intensities of helium nuclei and nuclei with $Z>5$ measured in this paper coincides well with literature data and have a degree factor of integral spectrum $(\gamma_Z\text{-}1)=1.60\pm0.08$ in the energy region $\geq$ 2 TeV. 17 refs.; 14 figs.; 16 tabs.

15183 (NIIYaF-MGU–89-14-91) **X-ray spectrometer-polarimeter for the surface component analysis under ionic excitation of characteristic radiation.** Germann, P.; Goryaga, N.G.; Kerkow, H.; Kondakov, Yu.V.; Petukhov, V.P.; Romanovskij, E.A.; Holldack, K. Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1989. 34p. (In Russian). Order Number DE91625050. Source: OSTI; NTIS (US Sales Only); INIS.

A measurement complex to study spectra and polarization of X radiation is developed. An X-ray spectrometer-polarimeter with energy resolution $2x10^{-2}$ and aperture ratio from 10^{-8} to 10^{-6} steradians in photon energy range from 0.5 to 10 keV is designed. Measurements of the element composition of production steel by the method of X radiation excitation by a proton impact are carried out.It is shown that the detection limit for impurities in steels at proton energy of 0.5 MeV is 10^{-2}%. 24 refs.; 12 figs.; 3 tabs.

15184 (NIKHEF-H–90-10) **Finite element calculations on rear calorimetermodules for the Zeus experiment.** Blankers, R. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. 1 Jul 1990. 44p. Order Number DE91625032. Source: OSTI; NTIS (US Sales Only); INIS.

The Zeus detector is developed to study electron-proton collisions at HERA storage ring at DESY in Hamburg. The detector is presently assembled and should be operational early 1991. The interaction point is amongst other things completely surrounded by a calorimeter, that is subdivided in 3 parts: the forward (FCAL), the

barrel (BCAL) and the rear calorimeter (RCAL). Both FCAL and RCAL is made of 24 modules, each 200 mm wide, the height is a function of its position and varies between 2.5 and 5 m. The depth of FCAL is about 2 m and for RCAL about 1.5 m. This report describes the results of a series of finite element calculations on the RCAL modules. The main motivation is to find out where in the module the maximum forces and stresses occur under different boundary and load-conditions. Chapters 2-3 give a short description of the module and a short introduction to the finite element methods. Chapters 4-5 describe the calculated loadcases and the resulting forces and stresses. (author). 4 refs.; 44 figs.; 24 tabs.

15185 (NIKHEF-K-DIGEL–1989-9) **LVDT with conditioner for control of step-engine drivers: Part of the sliding-foil system of the Emin spectrometers.** Es, J.T. van; Trigt, J. van. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K. 1 Nov 1989. 10p. (In Dutch). (MUTAD–891101.). Order Number DE91626041. Source: OSTI; NTIS (US Sales Only); INIS.

Up till now micro-switches has been employed to detect the dropping-behind of the foil in order the spectrometer to be followed properly by the sliding-foil. The pressed micro-switch made run the step motor until the foil released the micro-switch. This caused a jerkily following of the foil when the spectrometers were rotated. The replacing system uses a Linear Variable Differential Transformer (LVDT) to detect the follow-error. The LVDT yields a signal which is proportional with the follow-error. This signal is transformed in a frequency in the conditioner which is proportional to the follow-error. During the rotation of the spectrometers the step motors will run continuously in order to zero the follow-error. A LVDT has been chosen as follow detector since it does not have wearing components, is not sensitive to contamination and can resist a rather high radiation dose. The totally integrated flux for Schaevitz LVDT's with opt.120 is 10^{12} NVT and for the XS-ZTR design $3*10'2^{0}$ NVT. (author). 3 figs.

15186 (NIKHEF-K-DIGEL–1990) **Programmable pseudo-random detector-pulse-pattern generator: Final term subject.** Putten, R. van der (Hogeschool Alkmaar (Netherlands)). Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K. 1990. 68p. (In Dutch). Order Number DE91625014. Source: OSTI; NTIS (US Sales Only); INIS.

This report discusses the design and realization of the digital part of the programmable pseudo-random detector pulse-pattern generator. For the design and realization use has been made of F-TTL and high speed special purpose ic's, in particular FAL's (15 ns). The design possibilities offered by the software for pro-gramming of the FAL's have been utilized as much as possible. In this way counters, registers and a state machine with extended control possibilities have been designed and an advanced 8 channel pulse generator has been developed which is controlled via the VME system bus. the generator possesses an internal clock oscillator of 16 MHZ. The moment when a pulse is generated can be adjusted with a step size of 250 ps. 2000 different periods (time windows) can be stored for generating a pattern. (author). 37 refs.; 6 figs.

15187 (NIKHEF-K-DIGEL–1990-3) **Time-interpolator: Final term subject.** Blok, M. de (Algemene Hogeschool Amsterdam (Netherlands)). Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K. 8 Jun 1990. 44p. (In Dutch). Order Number DE91625015. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes a time-interpolator with which time differences can be measured using digital and analog techniques. It concerns a maximum measuring time of 6.4 μs with a resolution of 100 ps. Use is made of Emitter Coupled Logic (ECL) and analogues of high-frequency techniques. The difficulty which accompanies the use of ECL-logic is keeping as short as possible the mutual connections and closing properly the outputs in order to avoid reflections. The digital part of the time-interpolator consists of a continuous running clock and logic which converts an input signal into a start- and stop signal. The analog part consists of a Time to Amplitude Converter (TAC) and an analog to digital converter. (author). 3 refs.; 30 figs.

15188 (NIKHEF-K-DIGEL–1990-4) **Digital time-interpolator: Final term subject.** Schuller, S. (Algemene Hogeschool Amsterdam (Netherlands)). Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie K. 22 Jun 1990. 47p. (In Dutch). Order Number DE91625016. Source: OSTI; NTIS (US Sales Only); INIS.

This report presents a description of the design of a digital time meter. This time meter should be able to measure, by means of interpolation, times of 100 ns with an accuracy of 50 ps. In order to determine the best principle for interpolation, three methods were simulated at the computer with a Pascal code. On the basis of this the best method was chosen and used in the design. In order to test the principal operation of the circuit a part of the circuit was constructed with which the interpolation could be tested. The remainder of the circuit was simulated with a computer. So there are no data available about the operation of the complete circuit in practice. The interpolation part however is the most critical part, the remainder of the circuit is more or less simple logic. Besides this report also gives a description of the principle of interpolation and the design of the circuit. The measurement results at the prototype are presented finally. (author). 3 refs.; 37 figs.; 2 tabs.

15189 (ORNL/FTR–3881) **[The design of calorimeters for the L* detector]: Foreign trip report, March 3–9, 1991.** Moore, J.W.; Rennich, M.J. Oak Ridge National Lab., TN (USA). 8 Apr 1991. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010565. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The primary purpose of this trip was to attend the two days of meetings of the L* Collaboration. In addition, the L3 detector at CERN was visited and meetings were held to discuss the design and fabrication of the L* BaF2 electromagnetic calorimeter.

15190 (PNL-SA–17139) **Survey instrument response to beta radiations.** Swinth, K.L.; Sisk, D.R. Pacific Northwest Lab., Richland, WA (USA). Oct 1989. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. (CONF-900143–38: Institute for Electronic and Electrical Engineers (IEEE) nuclear science symposium, San Francisco, CA (USA), 15-19 Jan 1990). Order Number DE91010754. Source: OSTI; NTIS; INIS; GPO Dep.

Available survey instruments do not have the beta measurement characteristics needed for accurate dose rate assessments. Such instruments have severe angular and energy dependence. In addition, beta measurements often require corrections for the source geometry response of the detector to permit accurate assessments. Studies were performed to characterize present instruments and to determine optimum characteristics for a field instrument. Results of the studies were used to specify and procure an instrument with improved characteristics. The purpose of this paper is to describe the results of the studies and the design of the instrument. 6 refs., 6 figs., 4 tabs.

15191 (RAL–90-088) **The RAL 10 discriminator.** White, D.J. Rutherford Appleton Lab., Chilton (UK). Nov 1990. 9p. Order Number DE91625033. Source: OSTI; NTIS (US Sales Only); INIS.

As an exercise in integrated circuit design it was decided to attempt the difficult task of producing a discriminator which would meet the exacting requirements of two co-ordinate readout of multiwire drift chambers by timing methods. Such a circuit would have a wide range of uses in High Energy Physics and other applications requiring extreme timing performance. (author).

15192 (RISO-M–2897) **Procedures to analyse γ-ray spectra obtained from the ORTEC or nuclear data ND-680 system by ORTEC's analysis software packages incorporated into a separate IBM-PC computer.** Zhang Xiu Zhen. Risoe National Lab., Roskilde (Denmark). Jan 1990. 23p. Order Number DE91625017. Source: OSTI; NTIS (US Sales Only); INIS.

A detailed description is presented for processing γ-spectra produced by means of Ortec or Nuclear Data spectrometry systems on an off-line IBM-PC. The ORTEC analysis software packages were transferred to and implemented on the PC A/T, and the different spectra were recorded on discs and subsequently brought into the format required by the program for the calculation of photo peak areas. (author).

15193 (UCRL-ID–106311) **Absolute calibration in vivo measurement systems.** Kruchten, D.A.; Hickman, D.P. Lawrence Livermore National Lab., CA (USA). Feb 1991. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91009719. Source: OSTI; NTIS; INIS; GPO Dep.

Lawrence Livermore National Laboratory (LLNL) is currently investigating a new method for obtaining absolute calibration factors for radiation measurement systems used to measure internally deposited radionuclides in vivo. Absolute calibration of in vivo measurement systems will eliminate the need to generate a series of human surrogate structures (i.e., phantoms) for calibrating in vivo measurement systems. The absolute calibration of in vivo measurement systems utilizes magnetic resonance imaging (MRI) to define physiological structure, size, and composition. The MRI image provides a digitized representation of the physiological structure, which allows for any mathematical distribution of radionuclides within the body. Using Monte Carlo transport codes, the emission spectrum from the body is predicted. The in vivo measurement equipment is calibrated using the Monte Carlo code and adjusting for the intrinsic properties of the detection system. The calibration factors are verified using measurements of existing phantoms and previously obtained measurements of human volunteers. 8 refs.

15194 (USIP–90-06) **Cosmic-ray muons as a calibration source for high-energy gamma-ray detectors.** Thoerngren Engblom, P. Stockholm Univ. (Sweden). Inst. of Physics. Sep 1990. 19p. Order Number DE91626042. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper a measurement of the directional distribution of cosmic-ray muons, at the latitude of Stockholm, is reported. In fitting the measured flux to a simple analytical expression, the distribution was found to be symmetric around a line approximately to the northwest at 4.2+-0.7 degrees from zenith. The east-west asymmetry amounted to a difference in the total intensity of 20+-4% at the zenith angle of 45 degrees. The spectra of energies deposited by the muons in a BGO-detector orientated at different angles, are obtained through a Monte Carlo-simulation, where the muon distribution is used as a weight function for sampling muons in different directions. (author).

4402 Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to citation(s) 14947, 15049

4404 Well Logging Instrumentation

Refer also to citation(s) 14015

15195 Logging method and apparatus using a rotating sensor. Huau, C. 17 Sep 1990. Filed date 5 Mar 1990. Canada Patent patent application 2011437. 27p. Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

This invention relates to a logging method using a rotating sensor such as a sonic or ultrasonic sensor to scan the wall of the borehole circumferentially, and to apparatus for implementing the method. The object of the invention is to provide a logging method and apparatus in which a target can be placed in front of a sensor pointing towards the borehole wall in order to allow calibration of the sensor under conditions which are close to those which prevail during measurement. According to the invention, this result is obtained by a logging method comprising a measurement step in which a sensor is caused to rotate in one direction in order to scan the borehole wall circumferentially, and a calibration step in which the sensor and a target are brought face to face by reversing the direction of rotation of the sensor, whereby a reference measurement for calibrating the sensor can be obtained. The apparatus of the invention comprises a housing, a sensor rotatable about the longitudinal axis of the housing, drive means for rotating the sensor, a target, and displacement means responsive to the direction of rotation of the sensor for displacing the sensor and the target. 5 figs.

15196 Method and apparatus to receive and transmit signals in wells, especially horizontal wells. Mari, J.-L. 10 Jul 1990. France Patent priority 8815654;CA patent application 2004055. 22p. (In French). Source: Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN.

A method for acquiring and processing recordings obtained by a well logging tool allows a better discrimination between the discontinuities of the subsoil oriented substantially in the same direction as the well and situated on both sides of the latter, and notably in a substantially horizontal well. The method comprises displacing the tool along the well and the carrying out of at least two series of transmitting, receiving, and recording of signals. The position of the transmission and/or receiving means of the signals relative to the axis of the well is different from one series to the other, such as to vary their distance to the discontinuities on both sides of the well. A combination of recordings relative to these series of cycles allows dissociation of the reflections according to the side of the well from which they originate. This invention is applicable to sonic, electromagnetic, or other types of well logging. 6 figs.

4405 Thermal Instrumentation

Refer also to citation(s) 14349, 14840, 15180

15197 (ECN-RX–90-090) **An apparatus for calorimetric measurement of ac losses in superconductors.** Eikelboom, J.A. Netherlands Energy Research Foundation, Petten (Netherlands). Nov 1990. 7p. Order Number DE91760544. Source: OSTI; NTIS (US Sales Only).

A new method to measure calorimetrically ac losses in superconducting samples is described. The boil-off gas is stored below the liquid helium level in a measuring tube. Losses in the range of 1 mW up to 100 mW can be measured with an accuracy of 3%. Measurements can be performed with short time intervals as equilibrium conditions are determined by the thermal properties of the sample alone. 2 figs., 2 refs.

4406 Optical Instrumentation

Refer also to citation(s) 14925, 15516, 15817, 15819

15198 (EGG–10617-5039) **Design of a twenty-element long focal length zoom lens.** Malone, R.M. (EG and G, Inc., Los Alamos, NM (USA)); Frogget, B.C.; Grafton, D.A.; Mitchell, F.R. EG and G, Inc., Los Alamos, NM (USA). [1990]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC08-88NV10617. (CONF-900756–60: 34. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering, San Diego, CA (USA), 8-13 Jul 1990). Order Number DE91010770. Source: OSTI; NTIS; GPO Dep.

An optical lens system with varying magnification has been designed for a 70-mm image format. Twenty optical elements were needed to provide for the 345- to 1050-mm focal length zoom range as well as the proper color correction over the visible spectrum. A 4-in diameter port window limits the f/# of the optical lens system. Operation of the lens system is done by actuating stepping motors through a MacPlus computer. This lens system was designed for Los Alamos National Laboratory Group M-8, because no commercial zoom lens existed that would change its reduction from 1/15 to 1/4 at a focusing range of 5 meters. Additionally, we required a larger, non-standard image size that could be recorded by a rotating mirror streak camera. A Nikkor lens sales manual does offer a long focal length, 35-mm lens only upon special order. The closest focusing range of this Nikkor lens is 6 meters. 2 refs., 4 figs., 1 tab.

4407 Geophysical and Meteorological Instrumentation

Refer also to citation(s) 14262, 15325

15199 (EGG–10617-1109) **High resolution seismic data acquisition system.** Carrel, J.R. EG and G Energy Measurements, Inc., Las Vegas, NV (USA). [1991]. 14p. Sponsored by USDOE,

Washington, DC (USA). DOE Contract AC08-88NV10617. (CONF-910598–4: 37. Instrument Society of America international instrumentation symposium, San Diego, CA (USA), 5-9 May 1991). Order Number DE91010769. Source: OSTI; NTIS; GPO Dep.

This article presents the design of a data acquisition system that was developed by EG&G Energy Measurements (EG&G/EM) for Sandia National Laboratories (SNL). The acquisition system comprises individual seismometers that measure seismic activity at remote stations located several hundred miles from a central data collection facility and control point. The remote stations operate unattended and receive commands for setup, status check, and software modifications from the control point. At the remote station, the data from the seismometers, ranging from 1 microvolt to 4 volts, is digitized and transmitted over telephone lines to the central collection point. Because of the wide-dynamic input voltage range, the system was designed with a 20-bit delta-sigma analog-to-digital converter. Errors due to noise were kept to a minimum by careful selection of components and effective packaging design; nonlinearity was reduced by oversampling the input signal and then digitally filtering the sampled data. 8 refs., 5 figs.

15200 (RISO-M–2878) **Calibration of Rosemount M858 Pitot tube sensor.** Schmidt Paulsen, U. Risoe National Lab., Roskilde (Denmark). Test Station for Wind Turbines. Nov 1990. 30p. Order Number DE91763377. Source: OSTI; NTIS (US Sales Only).

The report describes the calibration of the instrument in the angle of attack and the sideslip plane versus different geometrical angles in the range of -20 to 20 Deg at windspeeds of 15 m/s and 30 m/s. The measurements were performed in the wind tunnel of the Danish Maritime Institute (DMI). (author).

4408 Miscellaneous Instrumentation

Refer also to citation(s) 15061, 15443, 15506

15201 (LIYaF–1463) **Automatic apparatus for measuring the magnetic and kinetic properties of high-temperature superconductors and magnetics.** Vasil'ev, A.A. (and others); Volkov, N.A.; Kozlov, S.M. AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki. 1988. 37p. (In Russian). Order Number DE91625078. Source: OSTI; NTIS (US Sales Only); INIS.

The automatic apparatus is described aimed at the investigation of the complex magnetic permeability in the radio frequency range and the DC conductivity of the high temperature superconducting ceramics as function of temperature (in the range of 6-300K) and magnetic field (up to 1.6 T). The capabilities for observation of magnetic transitions in other materials are described. 4 refs.; 14 figs.; 2 tabs.

15202 (SAND–90-0945) **Effect of atmospheric variations on electromagnetic distance measurements.** Solomon, O.M. Jr. Sandia National Labs., Albuquerque, NM (USA). Dec 1990. 36p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009726. Source: OSTI; NTIS; GPO Dep.

This report describes some field tests of the CUBIC CR-100 distance measuring equipment. The distance measurements depend on the refractivity of the atmospheric. The CR-100 uses 320 for the refractivity. For the Albuquerque area on a clear spring day, 220 is a more realistic value for refractivity. This difference of 100 between the actual and assumed refractivities causes the range error to accumulate at the rate of 1 meter per 10,000 meters of range. For example, a difference of 100 in refractivity forces the measured range to contain an error of 5 meters for a 50,000 meter baseline. 12 figs.

15203 (UCRL-CR–105944) **A submicron resolution monolithic capacitive displacement sensor with digital output: Final report.** Current, W. (California Univ., Davis, CA (USA). Dept. of Electrical Engineering and Computer Science); Chau, Pak Shing. Lawrence Livermore National Lab., CA (USA); California Univ., Davis, CA (USA). Dept. of Electrical Engineering and Computer Science. 31 Oct 1990. 40p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91009765. Source: OSTI; NTIS; GPO Dep.

The goal of the project is to design, layout, fabricate, and test a monolithic capacitive displacement sensor prototype. This design is initially motivated for application in electronic tagging devices; however, the final design is general enough for other applications, such as monitoring movement of micro-machine parts. This new design utilizes a split grating electrodes configuration which makes the extraction of displacement information more convenient than other configurations. The measurement resolution is designed to be less than 1 micron. The overall design takes one master clock input, one reset input and requires 5V and ±2.5V power supplies and several external resistors. The output is 9-bit digital encoding of the displacement measured. One of the advantages of a capacitive displacement sensor is that it works on a noncontacting measurement principle. It is non-invasive, compact, and its sensitivity to spurious rotation, tilt or transverse movement of the electrode planes in very small. Applications of this type of sensor are numerous. For instance, calipers, electronic tagging devices, and a displacement feedback block for micro-machined structures. 3 refs., 20 figs.

45 MILITARY TECHNOLOGY, WEAPONRY, AND NATIONAL DEFENSE

Refer also to citation(s) 14836

15204 (K/DSRD–263/R1) **Confirming the Lanchestrian linear-logarithmic model of attrition: Revision 1.** Hartley, D.S. III. Oak Ridge K-25 Site, TN (USA). Dec 1990. 143p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract AC05-84OT21400. Order Number DE91009111. Source: OSTI; NTIS; GPO Dep.

This paper is the fourth in a series of reports on the breakthrough research in historical validation of attrition in conflict. Significant defense policy decisions, including weapons acquisition and arms reduction, are based in part on models of conflict. Most of these models are driven by their attrition algorithms, usually forms of the Lanchester square and linear laws. None of these algorithms have been validated. The results of this paper confirm the results of earlier papers, using a large database of historical results. The homogeneous linear-logarithmic Lanchestrian attrition model is validated to the extent possible with current initial and final force size data and is consistent with the Iwo Jima data. A particular differential linear-logarithmic model is described that fits the data very well. A version of Helmbold's victory predicting parameter is also confirmed, with an associated probability function. The implications of these findings are potentially far-reaching. Two-sided daily attrition data on a large number of battles is needed to absolutely confirm these results. Such a confirmation will require that numerous computer conflict models containing square and linear law based attrition algorithms be reexamined. It is conceivable that complex mixed, heterogeneous, square plus linear law algorithms may produce the same results as a homogeneous mixed linear-logarithmic law algorithm; however, such an occurrence is by no means assured. Even without such absolute confirmation, the results of this research allow the analysis of combat data for the effects of training, weather, leadership, and other human factors, unencumbered by the force size effects.

15205 (LA–11898-MS) **Distributed radar sensors for aircraft detection.** Canavan, G.H. Los Alamos National Lab., NM (USA). Apr 1991. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91009845. Source: OSTI; NTIS; GPO Dep.

Radars suitable for aircraft detection could be deployed on singlet space-based interceptor (SBI) platforms. They could operate at short ranges and still achieve useful search rates. Powers are modest and insensitive to frequency; the dominant costs are the pulsers and phased-array elements. A fundamental simplification results from mounting the radar on the life jacket rather than the SBI. Many satellites could be processed to derive aircraft trajectories sufficiently accurate for the commitment of fighters or defensive missiles. 4 refs., 10 figs.

15206 (LA–11921-MS) **Impact of force withdrawal on options for conventional defenses.** Canavan, G.H. Los Alamos

National Lab., NM (USA). Apr 1991. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91009844. Source: OSTI; NTIS; GPO Dep.

Soviet withdrawal from the Warsaw Treaty Organization (WTO) could open new defensive options. This report gives some background on those options from post-war nuclear and conventional strategies and the quantitative Soviet threat tot he role of firepower, close air support, and battlefield attrition. Withdrawal under the Conventional Forces in Europe (CFE) Treaty could provide a buffer between opposing armies that aggressor armies drop the bridges and disrupt the roads and rails that would have to be used. If forces were brought into battle piecemeal, they would be annihilated. That would permit effective use of advanced and prepositioned weapons, which would favor the defense. 9 refs.

15207 (ORNL/TM–11690) **DCOR: A deterministic combat model code.** Azmy, Y.Y. Oak Ridge National Lab., TN (USA). Apr 1991. 33p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010684. Source: OSTI; NTIS (US Sales Only); GPO Dep.

ORNL's deterministic combat model based on a system of PDEs is used to develop a flexible, user-friendly computer code called DCOR, for Deterministic Combat model of Oak Ridge, and previously known as WAR. The numerical solution of the PDEs is achieved via the Method of Lines (MOL) which approximates the spatial derivatives on a finite mesh yielding a set of ODEs that are solved using the Gear B Method. A general purpose software based on the MOL called PDETWO is used, with some modifications in DCOR, whereby the diffusion terms are approximated by a five-point finite-difference scheme and the convective terms are approximated by an upwind finite-difference representation. DCOR is an interactive code with graphical display capability for the solution, that permits external control by the user to simulate a wargame environment. A guide to the user of DCOR is included to help in setting up and modifying the input, either interactively or from a file. Preliminary results pertaining to the validation of the deterministic model with respect to a Monte Carlo simulation, to the accuracy of the numerical solution as the spatial mesh is refined, and to the versatility of DCOR is conducting sensitivity analyses are presented. 15 refs., 10 figs.

15208 (SAND–90-2178C) **A vortex panel method for calculating aircraft downwash on parachute trajectories.** Fullerton, T.L.; Strickland, J.H.; Sundberg, W.D. Sandia National Labs., Albuquerque, NM (USA). [1991]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9104171–7: 11. AIAA aerodynamic decelerator systems technology conference, San Diego, CA (USA), 9-11 Apr 1991). Order Number DE91009764. Source: OSTI; NTIS; GPO Dep.

This paper presents a discussion of a methodology of the paneled-wing method for calculating aircraft-induced wake velocities. This discussion will include a description of how an aircraft and its wake are represented by finite length vortex filaments, how the strength and location of these filaments are determined based upon aircraft characteristics and trajectory data, and how the induced velocity values are determined once the location and strength of the vortex filaments are known. Examples will be presented showing comparisons between induced velocity values calculated using both the paneled-wing method and Strickland's lifting line method. Comparison is also made between calculated results from the paneled-wing method and wind tunnel data collected in the wake of a scale model aircraft. Additional examples will show the effect of including aircraft downwash calculations in a trajectory analysis for a parachute-retarded store delivered via aircraft. 3 refs., 12 figs.

15209 (SAND–90-2564) **IOSAFS Phase 2 enhancements.** Mittas, A. Sandia National Labs., Albuquerque, NM (USA). Feb 1991. 31p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009728. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This paper describes testing done on a 4 W prototype laser diode, a 4 V solar cell fabricated at Sandia, a 0.165 μF mylar capacitor, and a 4 V-to-3 kV dc-dc converter. 3 refs., 33 figs., 2 tabs.

15210 (SAND–91-0531C) **An introduction to testing parachutes in wind tunnels.** Macha, J. Sandia National Labs., Albuquerque, NM (USA). [1991]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (AIAA–91-0858;CONF-9104171–6: 11. AIAA aerodynamic decelerator systems technology conference, San Diego, CA (USA), 9-11 Apr 1991). Order Number DE91009166. Source: OSTI; NTIS; GPO Dep.

This paper reviews some of the technical considerations and current practices for testing parachutes in conventional wind tunnels. Special challenges to the experimentalist caused by the fabric construction, flexible geometry, and buff shape of parachutes are discussed. In particular, the topics of measurement technique, similarity considerations, and wall interference are addressed in a summary manner. Many references are cited which provide detailed coverage of the state of the art in testing methods. From the discussions presented, it is obvious that there are some serious problems with state of the art methods, especially in the area of canopy instrumentation and when working with reduced-scale models. But if the experimentalist is informed about the relative importance of the various factors for a specific test objective, it is usually possible to design a test that will yield meaningful results. The lower cost and the more favorable measurement environment of wind tunnels make their use an attractive alternative to flight testing whenever possible. 26 refs., 5 figs., 1 tab.

15211 (UCRL-CR–106704) **Response of simulated propellants and explosives to projectile impact.** Yuan, W. Lawrence Livermore National Lab., CA (USA). Nov 1990. 338p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. SNPE-UCB-ENG-6059 SNPE-UCB-ENG-6553;SNPE-49/86;SNPE-38/87;SNPE-3 Order Number DE91009777. Source: OSTI; NTIS; GPO Dep.

This dissertation deals with experimental, analytical and numerical investigations into the response of two types of simulated propellants and explosives, known as Propergol, to projectile impact. The targets consisted of a polymeric mixture composed of potassium chloride, plaster of Paris and a polyurethane binder. Following the determination of the constitutive behavior of Propergol, experiments were conducted to study their penetration, perforation and fragmentation by projectiles. Both pneumatic and powder guns were employed in the tests, perfragmentation by projectiles. Both pneumatic and powder guns were employed in the tests, permitting impact velocities ranging from 40 to 1100 m/s, for flat- and conically-tipped as well as armor-piercing projectiles. The specimens include monolithic, composite and constrained Propergol circular disks and cylinders of 140 mm diameter with thicknesses ranging from 9 to 90 mm. Penetration tests were also conducted on model warheads loaded with the simulant material. Ballistic limit velocities for various target/projectile combinations were determined. Damage modes, such as cracking and fragmentation, were examined using experimental evidence including high-speed film data and microscopic photographs. Two types of fragments, Propergol clusters and crystalline particles, were recognized, and their size distributions were found to fit exponential functions. The dependent of fragment number and volume on initial projectile velocity was also studied. 103 refs., 172 figs., 19 tabs.

4501 Chemical Explosions and Explosives

Refer also to citation(s) 15211

15212 (UCRL-ID–106421) **High-explosive burn studies.** Bloom, G.H. Lawrence Livermore National Lab., CA (USA). Feb 1990. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91009720. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A series of burn tests were conducted to compare the results of an accidental fire involving TATB-based explosives vs one involving HMX-based explosives. The very insensitive TATB burns more than five times slower than HMX, providing a clear advantage in reduced heating and a significantly lower probability of a transition to detonation. 5 refs., 8 figs., 3 tabs.

4502 Nuclear Explosions and Explosives

Refer also to citation(s) 14306

15213 (CONF-8909163–Vol.1, pp. 281-283) **More about breathing on the Mesa.** Woodward, E.C. (Lawrence Livermore National Lab., CA (USA)). Lawrence Livermore National Lab., CA (USA). [1989]. From 5. symposium on containment of underground nuclear explosions; Santa Barbara, CA (USA); 19-21 Sep 1989. In *Proceedings of the fifth symposium on containment of underground nuclear explosions. Volume 1.* 394p. Source: OSTI; NTIS.

Atmospheric pressure cycling (breathing) has assisted diffusion in enabling gaseous radioactive fission debris to reach the surface, as detected by noble gas samplers, after a number of Pahute Mesa events. More and updated information on the geology and location of the breathing phenomenon may better define its likelihood of occurrence. Since September, 1987, seven events have been conducted on Pahute Mesa. The Trail Ridge Member of Thirsty Canyon Tuff was the surface member at three event sites and a member of the Timber Mountain Tuff group was the surface member at four event sites. Only after the KEARSARGE event in hole U19ax did noble gas samplers detect radioactive Krypton and Xenon. Whether this was due to breathing assisting diffusion through cracks caused by the KEARSARGE event is uncertain because of the proximity of the LABQUARK site, U19an, and post-shot drilling activities at KEARSARGE. Thus the table shows U19ax as maybe under Radiation Detected and the figure indicates Detected? Examination of downhole photography and site characteristics for preevent cracks in the Timber Mountain Tuff surface members shows no differences between those sites where breathing of radioactive noble gas occurred (some forty percent) and those sites where it did not occur. Since post event surface cracks where radioactive noble gas has been detected are some hundred metres or more from the emplacement hole this is not surprising. No event having the Trail Ridge member of Thirsty Canyon Tuff at the surface has had detectable breathing of radioactive noble gas.

15214 (DOE/NV–209-Rev.11) **Announced United States nuclear tests, July 1945–December 1990: Revision 11.** USDOE Nevada Operations Office, Las Vegas, NV (USA). Office of External Affairs. Jan 1991. 134p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009062. Source: OSTI; NTIS; GPO Dep.

This document lists chronologically and alphabetically by event name all nuclear tests conducted and announced by the United States from July 1945 to December 1990 with the exception of the GMX experiments. Discussion is included on test dates, test series, test yields, test locations, test types and purposes, test totals for Nevada Test Site (NTS) detection of radioactivity from NTS events, and categorization of NTS nuclear tests. Briefly discussed are agreements between the US and the Soviet Union regarding test banning. (MB)

15215 (LA–11869-MS) **A farewell to MX: Missile without a home.** Canavan, G.H. Los Alamos National Lab., NM (USA). Apr 1991. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91009848. Source: OSTI; NTIS; GPO Dep.

MX mobile basing has lost support; the inability to base it has undermined support for the missile. International events and domestic politics have removed the sanctions that made it possible to ignore vulnerability to surprise attacks. A combination of basing and defense could provide MX a solid base. 6 refs.

15216 (LA–12042-MS) **Interim report of the drilling history and analysis for Nevada Test Site hole UE3e#4.** Thompson, J.L. (comp.). Los Alamos National Lab., NM (USA). Apr 1991. 205p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91009529. Source: OSTI; NTIS; GPO Dep.

This report describes work at the hole UE3e#4 located at the Nevada Test Site. It contains an account of the events that led to the decision to drill at this location, a discussion of the geology and hydrology at the drill site, and a description of the radioactive material found there. The report includes as appendices an extensive set of documents produced by the several organizations involved in the work. 6 refs., 3 figs.

4505 Strategic Defense Initiative

15217 (LA–11888-MS) **SBI allocation between heavy and singlet missiles.** Canavan, G.H. Los Alamos National Lab., NM (USA). Apr 1991. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91009859. Source: OSTI; NTIS; GPO Dep.

The optimal allocation of space-based interceptors (SBIs) between fixed, heavy missiles and mobile singlets can be derived from approximate expressions for the boost-phase penetration of each. Singlets can cluster before launch and have shorter burn times, which reduce their availability to SBIs by an order of magnitude. Singlet penetration decreased slowly with the number of SBIs allocated to them; heavy missile penetration falls rapidly. The allocation to the heavy missiles falls linearly with their number. The penetration of heavy and singlet missiles is proportional to their numbers and inversely proportional to their availability. 8 refs., 2 figs.

15218 (UCRL-CR–106596) **Channel diagnostics for the multi-pulse-propagation experiments at ATA: Final report.** Stalder, K.R.; Williams, M.S.; Eckstrom, D.J. SRI International, Menlo Park, CA (USA). Molecular Physics Lab. Nov 1990. 62p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91009772. Source: OSTI; NTIS; GPO Dep.

Three different channel diagnostic instruments were prepared for the Fall and Winter 1989–1990 Advanced Test Accelerator (ATA) multi-pulse-propagation experiments. The first diagnostic consisted of an eight-beam laser deflection measurement of channel density profiles and time histories. Reduced density channels were observed under a variety of accelerator operating conditions. The magnitude, size, and position of these channels were measured and are explained on the basis of the prevailing beam conditions. The second diagnostic, consisting of optical emission measurements of beam currents and channel temperatures, confirmed previous observations of shorter optical Faraday cup pulses and, under some operating conditions, behavior uncorrelated with beam bug signals. The latter observations may be related to beam hose instabilities. Vibrational temperatures deduced from the optical fluorescence signals also show a trend of increasing during the later pulses in a burst. The third diagnostic, a CO_2 interferometer designed to measure on-axis conductivity levels, was built but not deployed. 21 refs., 22 figs., 9 tabs.

54 ENVIRONMENTAL SCIENCES

Refer also to citation(s) 14689, 14690, 14692, 14693

5401 Environmental Sciences, Atmospheric

Refer also to citation(s) 13996, 14094, 14322, 14326, 14341, 14493, 14494, 14497, 14498, 14700, 14702, 14728, 14748, 14756, 14807, 14812, 14818, 14886, 15302, 15306, 15328, 15330, 15385, 15433, 15436, 15440, 15443

15219 (ANL/PP–67217) **Methane emissions from sanitary landfills.** Bogner, J.E.; Vogt, M.C. Argonne National Lab., IL (USA). [1991]. 43p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. Order Number DE91010652. Source: OSTI; NTIS; GPO Dep.

Calculations for methane emissions from US landfills based on vertical soil gas concentration gradients at humid and semiarid field sites yield rates ranging from a minimum of 6.10×10^{-10} to a maximum of 2.18×10^{-6} g cm^{-2} s^{-1}. The lower value is for well-vegetated silty clay cover with low relief and soil moisture approaching saturation at a site in northeastern Illinois; the higher value is for nonvegetated sandy silty cover at a sloped site with low soil moisture in southern California. Rates vary seasonally at individual sites, depending on soil moisture and other variables. A

comparison of methane emission rates at the California site to estimated methane generation rates suggests that, in the absence of gas collection systems, most of the methane is vented through the cover. Saturation of cover materials induces lateral gas migration. Total methane emissions from US landfills are estimated by two methods: (1) methane generation rates applied to the total mass of landfilled refuse and (2) measured methane flux rates applied to the total US landfill area. This study focuses on measured methane flux rates. 55 refs., 4 figs., 3 tabs.

15220 (BNL–45879) **Tropospheric sampling with aircraft.** Daum, P.H.; Springston, S.R. Brookhaven National Lab., Upton, NY (USA). Mar 1991. 50p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-900402–13: 199. national meeting of the American Chemical Society (ACS), Boston, MA (USA), 22-27 Apr 1990). Order Number DE91009472. Source: OSTI; NTIS; GPO Dep.

As the atmospheric chemical community focuses more intensely on issues of global concern, requiring survey of the chemical composition of the remote atmosphere and study of chemical processes occurring well above the surface, a larger number of programs will use aircraft as either the principal sampling platform, or to augment measurements made by other means. Because aircraft measurements impose different, and frequently more stringent sets of requirements on techniques used to measure trace atmospheric species than surface measurements, there is a need to review these requirements and to show how various measurement methods have been designed or altered to meet the needs of aircraft use. We will focus our attention here on measurement of trace chemical species, that definition including trace gases as well as aerosol particles and cloud droplets. 97 refs.

15221 (DOE/PC/90293–T1) **[High temperature membranes for H_2S and SO_2 separations]: Quarterly progress report, September 1, 1990–December 31, 1990.** Winnick, J. Georgia Inst. of Tech., Atlanta, GA (USA). School of Chemical Engineering. 1990. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG22-90PC90293. Order Number DE91008534. Source: OSTI; NTIS; GPO Dep.

Research during the period of September 1, 1990 through December 31, 1990 focused on developing a tape-casting method with several binder formulations. These formulae were based on methyl cellulose, polyvinyl butyral and acrylic as polymeric binders. Several plasticizers were used to provide a flexible tape product. Most of this work was applied towards the development of a membrane to be used in the SO_2 separation process. The preparation of all three types is described. Several of the successful tapes were tested in the full cell apparatus with simulated flue gas flowing over both electrodes. Results of these tests are briefly discussed. Work in membrane development for the H_2S separator process has been concentrated in two areas. These were utilization of Metoramics ceramic binder systems to produce flexible green tapes of MgO, as opposed to the borosilicate tapes made for the SO_2 separation process, and work with full cell experiments using Zircar's woven zirconia cloths as a matrix material in the separator membranes. Results are discussed.

15222 (DOE/RL–90-28) **Environmental Restoration Remedial Action quality assurance requirements document.** USDOE Richland Operations Office, WA (USA). 18 Mar 1991. 256p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. Order Number DE91010103. Source: OSTI; NTIS; INIS; GPO Dep.

This document defines the quality assurance requirements for the US Department of Energy-Richland Operations Office Environmental Restoration Remedial Action program at the Hanford Site. The Environmental Restoration Remedial Action program implements significant commitments made by the US Department of Energy in the Hanford Federal Facility Agreement and Consent Order entered into with the Washington State Department of Ecology and the US Environmental Protection Agency. This document combines quality assurance requirements from various source documents into one set of requirements for use by the US Department of Energy-Richland Operations Office and other Environmental Restoration Remedial Action program participants. This document will serve as the basis for developing Quality Assurance Program Plans and implementing procedures by the participants. The requirements of this document will be applied to activities affecting quality, using a graded approach based on the importance of the item, service, or activity to the program objectives. The Quality Assurance Program that will be established using this document as the basis, together with other program and technical documents, form an integrated management control system for conducting the Environmental Restoration Remedial Action program activities in a manner that provides safety and protects the environment and public health.

15223 (ECN-I–90-037) **Performance of monitoring networks estimated from a Gaussian plume model.** Seebregts, A.J.; Hienen, J.F.A. Netherlands Energy Research Foundation, Petten (Netherlands). Oct 1990. 50p. Order Number DE91625734. Source: OSTI; NTIS (US Sales Only); INIS.

Includes list of symbols and notations.

In support of the ECN study on monitoring strategies after nuclear accidents, the present report describes the analysis of the performance of a monitoring network in a square grid. This network is used to estimate the distribution of the deposition pattern after a release of radioactivity into the atmosphere. The analysis is based upon a single release, a constant wind direction and an atmospheric dispersion according to a simplified Gaussian plume model. A technique is introduced to estimate the parameters in this Gaussian model based upon measurements at specific monitoring locations and linear regression, although this model is intrinsically non-linear. With these estimated parameters and the Gaussian model the distribution of the contamination due to deposition can be estimated. To investigate the relation between the network and the accuracy of the estimates for the deposition, deposition data have been generated by the Gaussian model, including a measurement error by a Monte Carlo simulation and this procedure has been repeated for several grid sizes, dispersion conditions, number of measurements per location, and errors per single measurement. The present technique has also been applied for the mesh sizes of two networks in the Netherlands, viz. the Landelijk Meetnet Radioaciviteit (National Measurement Network on Radioactivity, mesh size approx. 35 km) and the proposed Landelijk Meetnet Nucleaire Incidenten (National Measurement Network on Nuclear Incidents, mesh size approx. 15 km). The results show accuracies of 11 and 7 percent, respectively, if monitoring locations are used more than 10 km away from the postulated accident site. These figures are based upon 3 measurements per location and a dispersion during neutral weather with a wind velocity of 4 m/s. For stable weather conditions and low wind velocities, i.e. (Abstract Truncated)

15224 (ECN-I–90-047) **Extra air pollution on roads near parking facilities: Calculations with a modified CAR-model.** Boonekamp, P.G.M. Netherlands Energy Research Foundation, Petten (Netherlands). Nov 1990. 23p. (In Dutch). Order Number DE91760558. Source: OSTI; NTIS (US Sales Only).

Air pollution on roads near parking facilities is generally underestimated with dispersion models, such as the Dutch CAR-model, intended for determining immision levels from traffic intensities, road characteristics, and emission factors. This is caused by the extra emission at the beginning of a trip due to a 'cold' start and driving while the motor is still warming up. Because three-way catalyst systems are not functioning until they get hot enough this extra pollution during the first part of the trip remains a problem still to be solved. Another problem, specific to parking, is the 'hot soak' emission of benzene due to evaporation of petrol from the fuel system at the end of the trip. Using data from a recent measurement programme calculations have been made for CO, NO_2 and benzene with a modified CAR-model for a realistic parking situation to illustrate the case. 2 figs., 15 refs., 4 tabs., 1 app.

15225 (ECN-RX–90-082) **On comparing the emissions of different greenhouse gases.** Ybema, J.R. Netherlands Energy Research Foundation, Petten (Netherlands). Dec 1990. 31p. Order Number DE91760566. Source: OSTI; NTIS (US Sales Only).

The emission of non-CO_2 greenhouse gases should be included in evaluating strategies to reduce greenhouse gas emissions. For developing such strategies a distinction can be made between two extreme approaches: the limitation of the emissions of each greenhouse gas separately, and the limitation of the emissions of all

greenhouse gases together. The latter approach (integrated or bubble approach) has been worked out. Therefore at least two problems have to be dealt with: the potential of a gas for warming the atmosphere is determined by various properties (radiative force, atmospheric lifetime, indirect impacts), and in order to compare the emissions of various greenhouse gases these properties have to be caught in one single index. Uncertainty analysis has to be performed to account for major uncertainties in the greenhouse gas properties. A concept has been elaborated that, in finding optimal strategies to reduce the greenhouse gas emissions, includes the emissions of all greenhouse gases and allows trade between emission reductions of different gases. The total concept is expected to be applicable for use in various models, including the MARKAL energy model of the Netherlands. 6 figs., 24 refs., 12 tabs.

15226 (EGG–10617-1079) **An aerial radiological survey of the Fermi National Accelerator Laboratory and surrounding area, Batavia, Illinois: Date of survey: June 1989.** Fritzsche, A.E. EG and G Energy Measurements, Inc., Las Vegas, NV (USA). Remote Sensing Lab. Nov 1990. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC08-88NV10617. Order Number DE91010484. Source: OSTI; NTIS; INIS; GPO Dep.

An aerial radiological gamma survey was conducted over the Fermi National Accelerator Laboratory during 1 through 6 June 1989. Flight lines at 150-foot altitude and 250-foot line spacings assured nearly 100% coverage. The terrestrial exposure at about 6 μR/h was nearly the same as that measured by the previous survey of this area (May 1977). Ten anomalous areas, mostly Na-22 and Mn-54, were detected within buildings and laboratories in the area. Although these locations have changed somewhat from the 1977 survey, the aerial data shows good agreement with the ground-based ion chamber and soil sample data. 7 refs., 15 figs., 1 tab.

15227 (EGG-ESQ–9401) **Monitoring Activities Review action report for the Environmental Monitoring Program.** Wilhelmsen, R.N.; Wright, K.C. EG and G Idaho, Inc., Idaho Falls, ID (USA). Dec 1990. 35p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. Order Number DE91010085. Source: OSTI; NTIS; INIS; GPO Dep.

To improve program planning and to provide bases for technical improvement of the monitoring program, the EG&G Environmental Monitoring (EM) organization has regularly used the Monitoring Activities Review (MAR) process since 1982. Each MAR is conducted by a committee of individuals selected for their experience in the various types of monitoring performed by the EM organization. An MAR of the Environmental Monitoring Program was conducted in 1988. This action report identifies and discusses the recommendations of this MAR committee. This action report also identifies the actions already taken by the EM Unit in response to these recommendations, as well as the actions and schedules to be taken. 10 refs.

15228 (EGG-M–90364) **Implementation of the FAA research and development electromagnetic database.** McDowall, R.L. (Computer Resource Management, Inc., Atlantic City, NJ (USA)); Grush, D.J.; Cook, D.M.; Glynn, M.S. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1991]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-9104163–3: 1991 international conference on lightning and static electricity, Cocoa Beach, FL (USA), 16-19 Apr 1991). Order Number DE91010063. Source: OSTI; NTIS; GPO Dep.

The Idaho National Engineering Laboratory (INEL) has been assisting the Federal Aviation Administration (FAA) in developing a database of information about lightning. The FAA Research and Development Electromagnetic Database (FRED) will ultimately contain data from a variety of airborne and groundbased lightning research projects. This paper contains an outline of the data currently available in FRED. It also lists the data sources which the FAA intends to incorporate into FRED. In addition, it describes how the researcher may access and use the FRED menu system. 2 refs., 12 figs.

15229 (EGG-M–90553) **Integrated optic sensor for cropland ammonia volatilization measurement.** EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 14p. Sponsored by USDOE, Washington, DC (USA); Georgia Inst. of Tech., Atlanta, GA (USA). DOE Contract FC07-88ID12726. (CONF-901280–2: The American Society of Agricultural Engineers (ASAE) conference, Chicago, IL (USA), 18-21 Dec 1990). Order Number DE91010058. Source: OSTI; NTIS; GPO Dep.

Because it is a gas at atmospheric pressure, anhydrous NH_3 may be lost to the atmosphere during and after placement due to soil conditions and the depth and spacing of placement. Inadequate soil conditions, improper injector settings, and erroneous injection rates enhance this loss. Moreover, urea and urea-ammonium nitrate solution (UAN) are becoming the principal N sources for broadcast as well as placement application in agriculture. These sources are often not incorporated into the soil and may be less efficient sources of N fertilizers because of N loss via gaseous NH_3. Measurement of this volatile N is difficult, especially under field conditions. However, a precise and convenient method of measuring gaseous NH_3 near and above the soil surface is prerequisite to the development and evaluation of alternative fertilizer management strategies and application techniques which can reduce the potential for significant loss. Recent advances in integrated-optic (IO) based sensing offers the potential of measuring low levels of NH_3 loss from a cropping system in the range of 100 ppb. The integrated design of an IO system allows for a more durable device that can be mass produced at low cost. Utilization of this sensor technology may be a feasible approach but must be tested under practical conditions to assess accuracy and reliability. A project has been undertaken to develop an integrated-optic (IO) for monitoring NH_3 evolution from agricultural land. The project is divided into three phases: Phase I: laboratory and bench-scale research for the development of the basic sensor, Phase II: the development and testing of a field prototype, and Phase III: field evaluation of the device in an agricultural setting. 23 refs., 2 figs.

15230 (EGG-WTD–9387) **Engineering-scale dust control experiments.** Winberg, M.R.; Pawelko, R.J.; Jacobs, N.C.; Thompson, D.N. EG and G Idaho, Inc., Idaho Falls, ID (USA). Dec 1990. 57p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. Order Number DE91010084. Source: OSTI; NTIS; INIS; GPO Dep.

This report presents the results of engineering scale dust-control experiments relating to contamination control during handling of transuranic waste. These experiments focused on controlling dust during retrieval operations of buried waste where waste and soil are intimately mixed. Sources of dust generation during retrieval operations include digging, dumping, and vehicle traffic. Because contaminants are expected to attach to soil particles and move with the generated dust, control of the dust spread may be the key to contamination control. Dust control techniques examined in these experiments include the use of misting systems, soil fixatives, and dust suppression agents. The Dryfog Ultrasonic Misting Head, manufactured by Sonics, Incorporated, and ENTAC, an organic resin derived from tree sap manufactured by ENTAC Corporation, were tested. The results of the experiments include product performance and recommended application methods. 19 figs., 7 refs., 6 tabs.

15231 (EML–523) **The Across North America Tracer Experiment (ANATEX): Volume 4, Quality assurance of ground-level samplers and quality assessment of EML analysis of surface samples.** Lagomarsino, R.J.; Weber, T.J.; Latner, N. USDOE Environmental Measurements Lab., New York, NY (USA). Feb 1991. 74p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009715. Source: OSTI; NTIS; GPO Dep.

This report is the fourth in a series of interagency reports of the Across North America Tracer Experiment (ANATEX). ANATEX was a series of 33 tracer releases, conducted from January to March 1987, to simulate the atmospheric transport and dispersion of pollutants to distances of 3000 km. Different tracers were simultaneously released into the atmosphere from two release sites, Glasgow, MT, and St. Cloud, MN. Each site is separated by a distance of ~1000 km. The tracers were released for a period of 3 h, every 2.5 days, over an 82- to 83-day period. Programmable atmospheric tracer samplers were emplaced at 77 primary ground-level sampling stations, located in arcs ranging from 500 to 3000 km from the Montana release site. Ground-level air samples of 24-h duration were continuously collected at each station over the 83-day release period. Additional samplers were co-located at nine

stations to provide duplicate samples for quality assessment purposes. After the experimental phase was completed, additional daily samples were collected at the Environmental Measurements Laboratory's (EML) Chester, NJ, Regional Baseline Station to verify the ambient background concentration of each tracer and to provide samples for laboratory intercomparison analyses. Presented here are EML's modifications to improve the surface samplers, as well as the quality assurance procedures used for their preparation. In addition, estimates of precision of sampling and analysis for the surface samples analyzed by EML are presented. The effect of contaminants on the quality of analytical results is also discussed. 15 refs., 13 figs., 5 tabs.

15232 (HASL-300-Ed.27-Vol.1) **Environmental Measurements Laboratory (EML) procedures manual: 27th edition, Volume 1.** Chieco, N.A.; Bogen, D.C.; Knutson, E.O. (eds.). US-DOE Environmental Measurements Lab., New York, NY (USA). Nov 1990. 764p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91010178. Source: OSTI; NTIS; INIS; GPO Dep.

Volume 1 of this manual documents the procedures and existing technology that are currently used by the Environmental Measurements Laboratory. A section devoted to quality assurance has been included. These procedures have been updated and revised and new procedures have been added. They include: sampling; radiation measurements; analytical chemistry; radionuclide data; special facilities; and specifications. 228 refs., 62 figs., 37 tabs. (FL)

15233 (IC-90/295) **Clear sky solar insolation data for Islamabad.** Akhter, P. (International Centre for Theoretical Physics, Trieste (Italy)); Baig, A.; Mufti, A. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 11p. Order Number DE91625733. Source: OSTI; NTIS (US Sales Only); INIS.

Monthly average values of both integrated and instantaneous clear sky solar radiation components for Islamabad territory have been presented and discussed. The components include total, direct normal, direct horizontal, global and diffuse radiations, sun hours, number of clear days and temperature for solar energy applications. Beam irradiance values are used to get clear sky (maximum) sun hours by ab-initio. The need for replacing the conventional sunshine recorder is discussed. (author). 8 refs, 1 fig, 2 tabs.

15234 (INIS-GB-336) **Fifth annual report of RADMIL 1989/90.** Radioactivity Monitoring in Lancashire (RADMIL), Lancaster (UK). 1990 75p. Order Number DE91624623. Source: OSTI; NTIS (US Sales Only); INIS.

This report contains the results of monitoring radiation and radioactivity in the environment in Lancashire from April 1989 to March 1990. It contains external radiation measurements of environmental gamma radiation and exposure from beaches and the coastline. It also contains internal radioactivity measurements from airborne particulates, milk, meat, fish and shellfish, fruit and vegetables and other miscellaneous foods. (U.K.).

15235 (INIS-SU-231, pp. 99-103) **PURGA-K cryogenic sampler for radioactive gas and aerosol capture.** Gavrilin, Yu.I.; Margulis, U.Ya.; Khrushch, V.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143--: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

4 refs.; 1 fig. KRB-IV. Chast' 1.

Design of the PURGA-K cryogenic sampler for determination of radioactive gas and aerosol content in air is described. The sampler main advantage is that it provides complete capture and the following any-term storage of aerosol fractions and gaseous wastes, except hydrogen and represent radionuclide soletion in liquid air and are really for gamma radiometric or apectrometric analyses. The cryogenic sampler design includes different filter packets, hooked up to the sampler inlet, permitting to acquire additional data on composition of gaseous and aerosol radionuclide fractions. 4 refs.; 1 fig.

15236 (INIS-SU-231, pp. 109-113) **Model of aerosol particle size spectrum.** Zelenin, V.N.; Konstantinov, I.E.; Mikheenko, S.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143--: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Theoretical method of determination of radioactive aerosol particle size distribution is suggested. It is shown that as a model for particle size spectrum, arising in the main processes of radioactive aerosol production. Theoretically maximum position may be calculated considering ideal case of particle production, determining characteristic (critical) size for the given particle production mechanism on the basis of corresponding criterial equations.

15237 (INIS-SU-231, pp. 103-105) **AFA and AFAS analytical filter packets for studying radioactive iodine component composition in air medium.** Borisov, N.B.; Borisova, L.I.; Staristina, I.A.; Petryakov, I.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143--: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

4 refs.; 1 fig. KRB-IV. Chast' 1.

To analyse radioactive iodine content in gaseous effluents air the AFAS-I and AFAS-SKI filter packets are used. It is shown that, when trapping molecular ^{131}I vapors, very sharp sorption wave front is formed. Difficulty sorbed iodine fraction in the AFAS-I filter packet forms a gently sloping sorption wave front, which slope slightly varies in time. In the AFAS-SKI filter packet quick sorbent saturation takes place, sorption wave front is extended along the layer. 4 refs.; 1 fig.

15238 (IVO-A-04/90) **Impacts of climate change on energy production and consumption in Finland.** Aittoniemi, P. Imatran Voima Oy (IVO), Helsinki (Finland). Feb 1990. 129p. (In Finnish). Order Number DE91763450. Source: OSTI; NTIS (US Sales Only).

Direct influences of the greenhouse gas-induced climate change on the Finnish energy sector by the year 2025 are studied in this study. The climate change in Finland cannot be predicted reliably. On the basis of the literature study, the base case scenario for the energy economy and three climate change scenarios were chosen for the year 2025. The countermeasures to slow down climate change or the influences of the climate change on the economy or the industry sector were assumed not to affect in the base case scenario. The climate of the base case scenario was assumed to be similar to the present one. In the climate change scenarios, the annual mean temperature and the annual rainfall will rise from the values of today. In the study concerning the effects on the energy consumption, heating and cooling energy and the total electricity consumption were emphasized. The effects on hydropower production were studied in the Kemijoki river basin in particular. The effects on condensation power plants, solar and wind energy, biomass and peat production and possible effect of the rising level were considered. In the electricity production system of the base case scenario, the annual variable costs of the thermal power production were reduced in the climate change scenarios by 5%-15% as compared to the value of the base case scenario. The reduction was due to a decrease in the annual electricity consumption, levelling out of seasonal variations and the increase of hydropower production. The decrease in the combined heat and power production increased the variable costs to some extent. Changes elsewhere in the energy sector influenced less the electricity production system as a whole.

15239 (JAERI-M-90-217) **Measurement of the reduction of terrestrial gamma-ray dose rates by the snow cover using TL-dosimeters.** Sakamoto, Ryuichi (Japan Atomic Energy Research

Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Saito, Kimiaki; Nagaoka, Toshi; Tsutsumi, Masahiro; Moriuchi, Shigeru. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1990. 38p. (In Japanese). Order Number DE91767923. Source: OSTI; NTIS (US Sales Only); INIS.

The objective of the investigation is to make clear the effect of the snow cover on environmental gamma-ray field. The reduction in the natural terrestrial gamma-ray dose rate due to snow cover was measured by TL-dosimeters. The measurements were performed in autumn before snowfall and in winter from September 1987 through March 1988 in Nagaoka city, Niigata prefecture. The dosimeters were set at four points, both outside and inside of the houses, for three months. The penetration factors (ratios of terrestrial gamma-ray dose accumulated during snow covered period to those during snow free period) were 0.54-0.67 in the open field, and 0.73-0.95 in the houses. According to theoretical calculation by the Monte Carlo method and the published snowfall data, the corresponding penetration factor was estimated at 0.54 in an ideal open field. As a result, the measured penetration factors were larger than calculated one by 24 % at maximum. The variation of dose rate inside houses by the difference of the amount of snow fall has been investigated. In general, though the amount of snow fall changes every year, dose rates inside the house were proved to be affected little by them. And, the optimum value of snow density which adapted for inference of penetration factor was found to be 0.3 g/cm^3. The penetration factors inferred from snowdepth data for the year distributed between 0.6 and 1.0 in winter from November 1985 through April 1986 in Niigata prefecture. (author).

15240 (KTM/E-D–186) **Greenhouse gas emissions from energy production and consumption in Finland.** Bostroem, S. (Insinoeoeritoimisto Prosessikemia Ky, Turku (Finland)); Backman, R.; Hupa, M. Kauppa-ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. 1990. 61p. (In Finnish). Project KTM-43/881/89. Order Number DE91763438. Source: OSTI; NTIS (US Sales Only).

In this report an estimate of greenhouse gas (CO_2, CH_4 and N_2O) emissions related to energy production and consumption in Finland is presented. In addition to the emissions from fuel combustion (fossile and non-fossile), the emissions related to the production and distribution of fuels are also covered. For renewable fuels, carbon dioxide absorption from the atmosphere has been taken into account, as well as the consequences of peat production for the natural carbon cycle of bogs. In 1988 the Finnish carbon dioxide emission from fuel combustion was 70 million tons, the share of fossile fuel combustion being 52 million tons. In addition there were CH_4 and N_2O emissions from fuel combustion equivalent to approximately 7 million tons CO_2. The production and transportation of the fuels caused CO_2 and CH_4 emissions corresponding to approx. 9 million tons CO_2, including a 1.5 million ton carbon dioxide emission from Finnish oil refineries. Accounting for the emissions from fuel production, transportation and combustion as well as the carbon dioxide absorption related to renewable fuel production, the total net emission of greenhouse gases was equivalent to 67 million tons CO_2. Of this, industry accounted for 23 million tons, space heating for 21 million tons and traffic (including mobile machinery) for 17 million tons. Energy use in agriculture, households, construction, services and public consumption accounted for 7 million tons.

15241 (LA-UR–91-825) **Application of a three-dimensional, prognostic model to Mexico City air quality studies.** Williams, M.D.; Porch, W.M. Los Alamos National Lab., NM (USA). [1991]. 32p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910659–9: 84. annual meeting and exhibition of the Air and Waste Management Association (AWMA), Vancouver (Canada), 16-21 Jun 1991). Order Number DE91009944. Source: OSTI; NTIS; GPO Dep.

Los Alamos National Laboratory and Instituto Mexicano del Petroleo have embarked on a joint study of options for improving air quality in Mexico City. One of the first steps in the process is to develop an understanding of the existing air quality situation. In this context we have begun by modifying a three-dimensional, prognostic, higher order turbulence model for atmospheric circulation (HOTMAC) to threat domains which include an urbanized area. This sophisticated meteorological model is required because of the complexity of the terrain and the relative paucity of meteorological data. The basic model (HOTMAC) was modified to include an urban canopy and urban heat sources. HOTMAC has been used to drive a Monte-Carlo kernel dispersion code (RAPTAD). RAPTAD was used to model the flow of carbon monoxide and sulfur dioxide, and the results have been compared to measurements. In addition the modeled wind fields which are based on upper-level winds from the airport are compared to the measured low-level winds. Also, a four year history of temperature structure obtained from the rawinsode at the airport has been related to mixing parameters and less reactive pollutant measurements (such as carbon monoxide). 10 refs., 15 figs.

15242 (LA-UR–91-847) **An expanding grid photochemical model for visibility applications.** Williams, M.D.; Streit, G. Los Alamos National Lab., NM (USA). 1 Mar 1991. 30p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910659–10: 84. annual meeting and exhibition of the Air and Waste Management Association (AWMA), Vancouver (Canada), 16-21 Jun 1991). Order Number DE91009947. Source: OSTI; NTIS; GPO Dep.

Photochemical models for visibility applications normally suffer from several limitations which impair their application to point-source plumes. Lagrangian type models suffer from an inability to handle wind shear and reversing winds Eulerian based systems smear the plume unrealistically during the early part of its travel. To avoid these problems a new model has been developed and compared to measurements near a southwestern power plant. The new system is quasi-Lagrangian in that the grid at any point in time covers the volume occupied by contaminants at that time. Consequently, the modeled volume is small during the early portion of the plume and expands with time. The model is driven by winds, temperatures, and turbulences provided by a three-dimensional, prognostic, higher order turbulence, atmospheric circulation model (HOTMAC). In comparison with plume measurements in the southwest, the model produced reasonable predictions of dispersion and ozone, but underestimated sulfate formation. Nitrate predictions were much too low. 13 refs., 11 figs.

15243 (LBL–27311) **Unit costs of carbon savings from urban trees, rural trees, and electricity conservation: A utility cost perspective.** Krause, F.; Koomey, J. Lawrence Livermore National Lab., CA (USA). Jul 1990. 29p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010218. Source: OSTI; NTIS; GPO Dep.

This paper compares the cost of sequestered and conserved carbon from rural tree planting, urban tree planting, and efficiency improvements, from the perspective of an electric utility and its ratepayers. Of these three options, energy efficiency appears to be the most widely applicable and attractive carbon mitigation measure from the utility's perspective. The majority of the demand-side resources the authors consider would allow carbon savings at negative net cost, while rural trees almost always have positive net cost to the utility. Urban trees can in many cases be comparable in cost to conservation, but are subject to a larger number of constraints (particularly in siting). For example, conservation can work in almost every type of building, while urban trees are most likely to be successful for some fraction of residential and small commercial buildings. Rural tree planting, both in the US and abroad, is an important tool in combating global warming; however from the utility's perspective, this option appears to be less cost-effective than conservation or urban trees under a wide variety of different assumptions. 32 refs., 3 figs., 4 tabs.

15244 (LBL–27742) **Modeling radon entry into houses with basements: Model description and verification.** Revzan, K.L.; Fisk, W.J.; Gadgil, A.J. Lawrence Berkeley Lab., CA (USA). Jan 1991. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-900724–10: Indoor Air '90: 5th international conference on indoor air quality and climate, Toronto (Canada), 29 Jul - 3 aug 1990). Order Number DE91009330. Source: OSTI; NTIS; INIS; GPO Dep.

We model radon entry into basements using a previously developed three-dimensional steady-state finite difference model that has been modified in the following ways: first, cylindrical coordinates are used to take advantage of the symmetry of the problem

in the horizontal plant; second, the configuration of the basement has been made more realistic by incorporating the concrete footer; third, a quadratic relationship between the pressure and flow in the L-shaped gap between slab, footer, and wall has been employed; fourth, the natural convection of the soil gas which follows from the heating of the basement in winter has been taken into account. The temperature field in the soil is determined from the equation of energy conservation, using the basement, surface, and deep-soil temperatures as boundary conditions. The pressure field is determined from Darcy's law and the equation of mass conservation (continuity), assuming that there is no flow across any boundary except the soil surface (atmospheric pressure) and the opening in the basement shell (fixed pressure). After the pressure and temperatures field have been obtained the velocity field is found from Darcy's law. Finally, the radon concentration field is found from the equation of mass-transport. The convective radon entry rate through the opening or openings is then calculated. In this paper we describe the modified model, compare the predicted radon entry rates with and without the consideration of thermal convection, and compare the predicted rates with determined from data from 7 houses in the Spokane River valley of Washington and Idaho. Although the predicted rate is much lower than the mean of the rates determined from measurements, errors in the measurement of soil permeability and variations in the permeability of the area immediately under the basement slab, which has a significant influence on the pressure field, can account for the range of entry rates inferred from the data. 25 refs., 8 figs.

15245 (LBL-PUB–3083) **Concentrations of indoor pollutants (CIP) database user's manual (Version 4.0).** Apte, M.G.; Brown, S.R.; Corradi, C.A.; Felix, S.P.; Grimsrud, D.T.; Smith, B.V.; Traynor, G.W.; Woods, A.L. Lawrence Berkeley Lab., CA (USA). Oct 1990. 40p. Sponsored by USDOE, Washington, DC (USA); Electric Power Research Inst., Palo Alto, CA (USA); Gas Research Inst., Chicago, IL (USA). DOE Contract AC03-76SF00098. Order Number DE91009115. Source: OSTI; NTIS; GPO Dep.

This is the latest release of the database and the user manual. The user manual is a tutorial and reference for utilizing the CIP Database system. An installation guide is included to cover various hardware configurations. Numerous examples and explanations of the dialogue between the user and the database program are provided. It is hoped that this resource will, along with on-line help and the menu-driven software, make for a quick and easy learning curve. For the purposes of this manual, it is assumed that the user is acquainted with the goals of the CIP Database, which are: (1) to collect existing measurements of concentrations of indoor air pollutants in a user-oriented database and (2) to provide a repository of references citing measured field results openly accessible to a wide audience of researchers, policy makers, and others interested in the issues of indoor air quality. The database software, as distinct from the data, is contained in two files, CIP. EXE and PFIL.COM. CIP.EXE is made up of a number of programs written in dBase III command code and compiled using Clipper into a single, executable file. PFIL.COM is a program written in Turbo Pascal that handles the output of summary text files and is called from CIP.EXE. Version 4.0 of the CIP Database is current through March 1990.

15246 (LITH-IFM-R–182) **Successful reduction of mercury and dioxines in chimney exhausts from a household-refuse-fuelled heating plant.** Axelsson, L.; Lauber, A. Linkoeping Univ. (Sweden). Dept. of Physics and Measurement Technology. 25 Aug 1990. 14p. Order Number DE91763541. Source: OSTI; NTIS (US Sales Only).

When burning household refuse, the production of gaseous toxic agents is a problem of critical importance. In this paper, the application of a novel technique for mercury (Hg) and hydrogen chlorine (HCl) purification of waste gases is described and the results of several years successful use are presented. Hg and HCl concentrations in the chimney exhausts were reduced by a factor of 10, from typically 0.5 to 0.05 mg/Nm^3 for mercury and typically 1000 to under 100 mg/Nm^3 for HCl (Nm^3 = normal cubic meter dry exhaust gas with 10% CO_2). When combined with voluntary collection of mercury batteries in the area where household refuse is collected, a further reduction by a factor 2 was obtained. An unexpected bonus of the new reduction technique was a simultaneous reduction of the dioxine concentration in the chimney exhaust by a factor of 10 to 100, typically from 1 to 0.01 ng/Nm^3. (authors).

15247 (NUREG/CR–5656) **EXTRAN: A computer code for estimating concentrations of toxic substances at control room air intakes.** Ramsdell, J.V. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Safety Issue Resolution; Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 158p. Sponsored by Nuclear Regulatory Commission, Washington, DC (USA). DOE Contract AC06-76RL01830. (PNL–7510). Source: OSTI; NTIS; INIS; GPO.

This report presents the NRC staff with a tool for assessing the potential effects of accidental releases of radioactive materials and toxic substances on habitability of nuclear facility control rooms. The tool is a computer code that estimates concentrations at nuclear facility control room air intakes given information about the release and the environmental conditions. The name of the computer code is EXTRAN. EXTRAN combines procedures for estimating the amount of airborne material, a Gaussian puff dispersion model, and the most recent algorithms for estimating diffusion coefficients in building wakes. It is a modular computer code, written in FORTRAN-77, that runs on personal computers. It uses a math coprocessor, if present, but does not require one. Code output may be directed to a printer or disk files. 25 refs., 8 figs., 4 tabs.

15248 (ORNL/FTR–3890) **[Air flow patterns within buildings]: Foreign trip report, October 8, 1990–October 15, 1990.** Zhang, Jianshun (Illinois Univ., Urbana, IL (USA)). Oak Ridge National Lab., TN (USA). 29 Oct 1990. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010459. Source: OSTI; NTIS; GPO Dep.

Thirty-eight experts from 12 different IEA countries attended the meeting. The traveler represented US involvement in the Subtask 1 of the Annex 20 to attend the meeting. The studies of room air and air contaminant distribution conducted in the Bioenvironmental Engineering Research laboratory (BERL) at the University of Illinois, Urbana-Champaign, were summarized, and the activities of other US researchers were highlighted. International participants expressed a need for experimental data in one of the specified test cases (case d: free convection room flow) in Annex 20 to compare with the numerical simulation results already obtained by three different IEA participating countries, and hoped that the US will conduct this experiment with the Room Ventilation Simulator available at BERL. No other participating countries have the facilities to conduct the test. Numerical simulation and experimental measurements previously conducted by different countries for the other four test cases were compared and discussed and future work outlined. Topics of particular interest included the measurement of low air velocity in the occupied zone, the measurement of air velocities within the flow boundary layer over the ceiling of wall surfaces, modeling diffuser air jets, and non-symmetry and low turbulence characteristics of the ventilation flow.

15249 (ORNL/TM–11649) **Multiple-Aircraft Instantaneous Line Source (MAILS) dispersion model user's guide.** Liebsch, E.J. Oak Ridge National Lab., TN (USA). Mar 1991. 61p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010448. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report provides instructions for the use of the Multiple-Aircraft Instantaneous Line Source (MAILS) atmospheric-dispersion model. MAILS is intended as a screening model for prediction of air-quality impacts of air-pollution emissions from low-flying aircraft on military training routes (MTRs). An air-quality screening model is generally defined as one that provides worst-case concentration estimates and can be run quickly with a minimum of user input. The MAILS model predictions of pollutant concentrations are considered to be worst-case estimates because of the assumptions incorporated in the model design. 11 refs., 15 figs., 6 tabs.

15250 (ORNL/TM–11747) **Parallelizing the spectral transform method, Part 1.** Worley, P.H.; Drake, J.B. Oak Ridge National Lab., TN (USA). Mar 1991. 29p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010453. Source: OSTI; NTIS; GPO Dep.

The spectral transform method is a standard numerical technique used to solve partial differential equations on the sphere in global climate modeling. In particular, it is used in CCM1 and CCM2, the Community Climate Models developed at the National Center for Atmospheric Research. This paper describes initial experiences in parallelizing a program that uses the spectral transform method to solve the nonlinear shallow water equations on the sphere, showing that an efficient implementation is possible on the Intel iPSC/860. The use of PICL, a portable instrumented communication library, and ParaGraph, a performance visualization tool, in tuning the implementation is also described. The Legendre transform and the Fourier transform comprise the computational kernel of the spectral transform method. This paper is a case study of parallelizing the Legendre transform. For many problem sizes and numbers of processors, the spectral transform method can be parallelized efficiently by parallelizing only the Legendre transform. A subsequent paper will discuss parallelizing the Fourier transform as well. 42 refs., 5 figs., 8 tabs.

15251 (PNL–6450-40-HEDR) **Hanford Environmental Dose Reconstruction Project monthly report, February 1991.** Finch, S.M. (comp.). Pacific Northwest Lab., Richland, WA (USA). Feb 1991. 61p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009408. Source: OSTI; NTIS; GPO Dep.

The objective of the Hanford Environmental Dose Reconstruction Project is to estimate the radiation doses that populations could have received from nuclear operations at Hanford since 1944. The project is being managed and conducted by the Pacific Northwest Laboratory (PNL) under the direction of an independent Technical Steering Panel (TSP). The TSP consists of experts in environmental pathways, epidemiology, surface-water transport, ground-water transport, statistics, demography, agriculture, meteorology, nuclear engineering, radiation dosimetry, and cultural anthropology. Included are appointed technical members representing the states of Oregon and Washington, cultural and technical experts nominated by the regional Native American tribes, and an individual representing the public. The project is divided into the following technical tasks. These tasks correspond to the path radionuclides followed, from release to impact on humans (dose estimates): source terms; environmental transport; environmental monitoring data; demographics, agriculture, food habits; and environmental pathways and dose estimates. Project reports and references used in the reports are made available to the public in a public reading room. Project progress is documented in this monthly report, which is available to the public. 3 figs., 3 tabs.

15252 (PNL–7340-HEDR) **MESOILT2, a Lagrangian trajectory climatological dispersion model: Hanford Environmental Dose Reconstruction Project.** Ramsdell, J.V. Jr.; Burk, K.W. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 196p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91009779. Source: OSTI; NTIS; INIS; GPO Dep.

The objective of the Hanford Environmental Dose Reconstruction (HEDR) Project is to estimate the radiation dose that individuals could have received as a result of emissions from nuclear operations at the Hanford Site. An independent Technical Steering Panel (TSP) directs the project, which is conducted by the Pacific Northwest Laboratory (PNL). The TSP directed PNL to demonstrate that its recommended approach for dose reconstruction is technically feasible and practical. This demonstration was Phase 1 of the project. This report is specifically concerned with the approach that PNL recommends for dealing with the atmospheric pathway. The TSP established a model domain for the atmospheric pathway for Phase 1 that includes 10 counties in Washington and Oregon and covers several thousand square miles. It is unrealistic to assume that atmospheric models which estimate transport and diffusion based on the meteorological conditions near the point of release of material at the time of release are adequate for a region this large. As a result, PNL recommended use of a Lagrangian trajectory, puff dispersion model for the Phase I study. This report describes the MESOILT2 computer code and the atmospheric transport, diffusion, deposition, and depletion models used in Phase I. The contents of the report include a technical description of the models, a user's guide for the codes, and descriptions of the individual code elements. 53 refs., 17 figs., 5 tabs.

15253 (PNL–7670) **Computing and information sciences preliminary engineering design study.** Schroeder, J.O.; Pearson, E.W.; Thomas, J.J.; Brothers, J.W.; Campbell, W.K.; DeVaney, D.M.; Jones, D.R.; Littlefield, R.J.; Peterson, M.J. Pacific Northwest Lab., Richland, WA (USA). Apr 1991. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91010567. Source: OSTI; NTIS; GPO Dep.

This document presents the preliminary design concept for the integrated computing and information system to be included in the Environmental and Molecular Sciences Laboratory (EMSL) at the Pacific Northwest Laboratory, Richland, Washington, for the US Department of Energy (DOE). The EMSL is scheduled for completion and occupancy in 1994 or 1995 and will support the DOE environmental mission, in particular hazardous waste remediation. The focus of the report is on the Computing and Information Sciences engineering task of providing a fully integrated state-of-the-art computing environment for simulation, experimentation and analysis in support of molecular research. The EMSL will house two major research organizations, the Molecular Sciences Research Center (MSRC) and part of the Environmental Sciences Research Center (ESRC). Included in the report is a preliminary description of the computing and information system to be included. The proposed system architecture is based on a preliminary understanding of the EMSL users' needs for computational resources. As users understand more about the scientific challenges they face, the definition of the functional requirements will change. At the same time, the engineering team will be gaining experience with new computing technologies. Accordingly, the design architecture must evolve to reflect this new understanding of functional requirements and enabling technologies. 3 figs., 2 tabs.

15254 (RISO-M–2842) **Extreme values of wind speeds in Denmark.** Abild, J.; Nielsen, B. Risoe National Lab., Roskilde (Denmark). Meteorology and Wind Energy. Jan 1991. 106p. Order Number DE91763374. Source: OSTI; NTIS (US Sales Only).

This report contains extreme statistics for a full 9-year record of 10-min averages of wind speed obtained at Sprogoe in the Great Belt. Verification of the extreme data is provided through a comparison with extreme data from three other sites: Risoe, Nibe, and the Dan/Gorm field. The methodology includes terrain descriptions of the sites involved. Both the Sprogoe and Risoe data are corrected for terrain, wake, and tower shadow effects, on applying the double-vertical extrapolation procedure of the European Wind Atlas. Extreme statistics are applied for both raw and corrected data using the Peakover-Threshold method. Good resemblance is found between the extreme statistics based on corrected data from Sprogoe and Risoe. A four-year and nine-mounth record of maximum 3-sec averages of turbulent wind fluctuations within a 10-min record is available from the Sprogoe mast. Based on this record an extreme statistics analysis for gust speeds in stationary conditions is attempted, assuming independence between the mean wind speed and the relative gust amplitude. In addition, extreme gust speeds are presented from storm periods with prevailing short-term instationarity. Finally, a short note is given on long-term fluctuations of the wind climate in Denmark. (author). 38 tabs., 50 ills., 34 refs.

15255 (SAND–91-0444C) **Non-CFC cleaning of printed wiring boards.** Nigrey, P.J.; Arzigian, J.S. Sandia National Labs., Albuquerque, NM (USA). [1991]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910279–13: Environmentally conscious manufacturing/technology applications workshop, Albuquerque, NM (USA), 20-21 Feb 1991). Order Number DE91009252. Source: OSTI; NTIS; GPO Dep.

Recent government actions to eliminate Chlorofluorocarbons (CFCs) and Chlorinated Hydrocarbons (CHCs) from the industrial environment require the evaluation of new cleaning solvents and processes. High reliability printed wiring board (PWB) assemblies require cleaning to remove process materials which could lead to corrosion or degradation of the electrical performance of the boards. In the past, CFCs have been used extensively for PWB cleaning purposes. Concerns about CFC emissions and their effect on ozone depletion in the atmosphere, greater demands on cleaning systems, and the availability of alternative cleaning methods

are requiring manufacturers of electronic assemblies to reconsider the choice of cleaning methods. We will review some of the presently available cleaning solvents and discuss the results of our work using a terpene-based cleaner. 5 refs., 4 figs.

15256 (SAND–91-0454C) **Environmentally conscious manufacturing at Sandia National Laboratories.** Granoff, B. Sandia National Labs., Albuquerque, NM (USA). 20 Feb 1991. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910279–8: Environmentally conscious manufacturing/technology applications workshop, Albuquerque, NM (USA), 20-21 Feb 1991). Order Number DE91008255. Source: OSTI; NTIS; GPO Dep.

Environmentally Conscious Manufacturing (ECM) refers to those processes that reduce the harmful environmental impacts of manufacturing, including minimization of hazardous waste, reduction of energy consumption, improvement of materials utilization efficiency, and improvement of operational safety. Approaches involve substitution of non-hazardous for hazardous materials, replacement of existing processes with new, waste-free processes, and increased use of recycle. Reducing waste at the source, through ECM, saves energy and money – and provides value-added for the production and process. End-of-the-pipe treatment is much more expensive than waste minimization and ECM. Protecting the environment by reducing or eliminating waste is industrially efficient. Industry must create cleaner processes and products that contribute to profitability, rather than just focusing on pollution control. By expanding the return-on-investment equation, it can be shown that manufacturing products without producing hazardous wastes will result in an increase in industrial competitiveness. The optimum time to consider waste minimization is when a manufacturing process is first conceived. A significant and economically beneficial goal would be the development of zero effluent or closed loop manufacturing processes. Several programs at Sandia National Laboratories (SNL) are addressing the issues of waste minimization and pollution prevention through the application of ECM. Many of these programs involve collaboration with other national laboratories, industry, universities, and the production agencies. The following sections will provide a synopsis of Sandia's activities in ECM. 14 refs.

15257 (SNV–3700) **Emission of acidifying substances 1988.** National Swedish Environment Protection Board, Solna (Sweden). 1990. 20p. (In Swedish). Order Number DE91763506. Source: OSTI; NTIS (US Sales Only).

The emission of sulfur- and nitrogen oxide 1988 in Sweden was reduced by 60 resp 5 per cent compared to the 1980 figures. This can be compared to the targets 65 resp. 30 per cent for 1995 fixed by the Swedish parliament 1985. The report gives an analysis of the various sources of acidifying emissions during 1988, and notes in particular the change to recent, earlier years. The large reductions in sulfur dioxide are mainly due to reduced oil consumption; and to stricter rules for sulfur content of oil and for emissions from coal combustion. The emissions of nitrogen oxides from process industry are constant but slowly reducing from road traffic due to the increasing use of catalytic converters.

15258 (SNV–3718) **Phasing-out of CFCs in Sweden.** Oestman, A. National Environmental Protection Agency, Solna (Sweden). Nov 1989. 61p. (In Swedish). Order Number DE91763539. Source: OSTI; NTIS (US Sales Only).

This report comprises an inventory of the CFC-usage 1986 and 1988 as well as an examination of the prerequisites and effects of the governmental plan for the phase-out. The studied CFC application cover 98-99% of the totally consumed amount. The rest, 40-80 tonnes, is mainly found within the application degreasing/cleaning. (U.W.).

15259 (STEV-FBT–90-8) **On the high temperature sulphur capture by calcium based sorbents: Modelling of the calcination, sintering and sulphation of the sorbent.** Alvfors, P. (Royal Inst. of Tech., Stockholm (SE). Dept. of Heat Technology). Statens Energiverk, Stockholm (Sweden). 1990. 37p. Project STEV-276-233. Order Number DE91763507. Source: OSTI; NTIS (US Sales Only).

A model has been developed for the simulation of the chemical and physical processes taking place in a sorbent particle, consisting of limestone, or limestone with an inert content in the form of magnesium carbonate, injected into the furnace of a pulverized coal-fired or grate-fired boiler. This process is important since the reaction between limestone and the sulphur dioxide formed during the combustion of coal is one important way of sulphur capture. The characteristics of this process are: typical temperatures in the interval 900-1200 deg C, short residence time and hence short available reaction time for the sorbent particles, 1-2 seconds, and small sorbent particles, typically less then 50 μm. The model accounts for the three processes believed to be the major factors in determining the conversion of the calcium carbonate in the sorbent particles. These are: the calcination of the sorbent, which produces the reactive oxide through emittance of carbon dioxide, the sintering of the calcination product, leading to a decrease in the reactivity of the oxide through grain growth, and the sulphation of the reactive oxide. The sulphation model includes pore diffusion, diffusion through solid product layer and the chemical reaction on the active surface. The structural changes due to different molar volumes of reactant and product are accounted for as well as the influence that changing porosity has on the pore diffusion rate. Results from model simulations were compared with experimental data for verification. The model correctly predicts trends in conversion for different temperatures, sorbent particle sizes, sulphur dioxide concentrations, and inert content in the sorbent. It is a valuable tool for predicting the effects on the calcium conversion when changes are brought about in the parameters mentioned. (author) (23 figs., 46 refs.).

15260 (STEV-FBT–90-10) **PFBC-development.** Hinderson, A. (ABB Carbon AB, Finspaang (SE)); Liinanki, L.; Nystroem, O.; Pettersson, G. Statens Energiverk, Stockholm (Sweden). Oct 1989. 133p. (In Swedish). Project STEV-276-315. Order Number DE91763508. Source: OSTI; NTIS, US Sales Only.

NOx chemistry was studied on a pilot scale during testing in ABB Carbon's PFBC experimental facility and on a laboratory scale at the Institute of Energy Technology in Chalmers. The investigations into the reduction of NOx were directed towards the study of reduction by adding chemicals which react with NOx during the formation of nitrogen gas. The results of the investigation showed that, of the various chemicals, ammonia in water solution gives the biggest NOx reduction. The project 'Partial gasification PFBC/KTH' studied the possibilities of combining combustion and partial gasification of coal with the objective of improving the degree of efficiency of a PFBC plant. With partial gasification, a low value combustion gas is obtained from the PFBC and in such a way it is possible to obtain a higher temperature for the gas into the gas turbine and thereby improve the efficiency of the plant. The interesting concepts include a fluid bed gasifier where the pyrolysis to keep down the alkaline metal emissions takes place at 815-870 deg C. Sulphur retention of 90% is given when limestone or dolomite is added to the bed. Calculations for materials and energy balance show that there are no difficulties in obtaining an entry temperature of 1200 deg C for the gas to the gas turbine.

15261 (STEV-FBT–91-2) **NO_x and N_2O formation in a pressurized bench-scale fluidized bed reactor.** Ivarsson, E.L. (Chalmers Univ. of Tech., Goeteborg (SE). Dept. of Energy Conversion). Statens Energiverk, Stockholm (Sweden); Chalmers Univ. of Tech., Goeteborg (Sweden). Dept. of Energy Conversion. Dec 1990. 51p. Project STEV-276-362. (CTH-IE-A–90-186). Order Number DE91763551. Source: OSTI; NTIS (US Sales Only).

Formation of NO_x and N_2O in a bench-scale, pressurized fluidized bed reactor has been measured. Coal or other solid fuels were fed batch-wise and different types of experiments were carried out in order to separate primary chemical reactions from secondary ones. In one type of experiment, referred to as the differential mode, mainly the primary production of nitrogen oxides was studied, and in another type, referred to as the integral mode, secondary heterogeneous reactions of the nitrogen oxides were added through recirculation of the flue gases. The main objective of the experiments was to correlate the formation of NO_x and N_2O combustion conditions in general, and particularly to pressure. The measurement show that the NO_x formation decreases and the N_2O

formation increase with increasing pressure. An increase in temperature causes the NO_x yield to increase and the N_2O yield to decrease. The yields also depend on fuel type. Coke shows the highest NO_x yield when compared with bituminous and brown coal. Increasing the coal concentration in the bed reduces the net NO_x yield, implying that heterogeneous contact of the primary NO_x with burning coal surfaces is an important NO_x reduction mechanism. The NO_x reduction produces some N_2O, but the final N_2O levels are very low compared to emissions from full-scale fluidized bed boilers. The low levels are explained by N_2O destruction over the bed materials. Ash shows N_2O destruction activity over a very wide temperature range, whereas quartz is active only at high temperatures. N_2O yields are comparatively high in quartz beds at temperatures below 800 degrees C especially when recycling fuel gases for NO_x reduction. (authors) (25 figs., 34 refs.).

15262 (STEV-FBT–91-4) **Minimization of emission of chlorinated organic compounds at refuse incineration, stage 1.** Faengmark, I. (Umeaa Univ. (SE). Inst. foer Miljoekemi); Marklund, S.; Rappe, C.; Stroemberg, B.; Berge, N. Statens Energiverk, Stockholm (Sweden); Studsvik Energy, Nykoeping (Sweden). Nov 1990. 145p. (In Swedish). Project STEV-276-373. (STUDSVIK-EP–90-25). Order Number DE91763553. Source: OSTI; NTIS (US Sales Only).

This project aims at elucidating which parameters are the most important in 'dioxin'-emission. The study comprises four specific areas: * Development of experimental rig for simulation of refuse boilers. * Development of fuels for simulation of municipal wastes, * Verification of experiment reactor and experiment fuel, * Sieving trials to find significant combustion parameters. The reactor is fired with a pelletized fuel consisting of a well controlled mixture and paper pulp, plastics, organic material and metal salts. It has been shown that the pilot plant can be fired with the same temperature, gas mixtures and residence times, as is relevant for full size boiler conditions. The emission is also of the same type in the pilot plants and the analyzed compounds occur in the same size classes and amounts. The temperature in the cooling section exerts the strongest influence on the 'dioxin'-emission. Parameters like H_2O- and HCl-concentration showed no statistically significant influence. (U.W.) (numerous figures and tables).

15263 (UCRL-JC–105011) **Gravity spreading in the dispersion of dense gas plumes.** Ermak, D.L. Lawrence Livermore National Lab., CA (USA). Mar 1991. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Contract MIPR N90-29. (CONF-910530–1: International conference and workshop on modeling and mitigating the consequences of accidental releases of hazardous materials, New Orleans, LA (USA), 6-10 May 1991). Order Number DE91010155. Source: OSTI; NTIS; GPO Dep.

The atmospheric dispersion of a denser-than-air release is affected by several physical phenomena that either do not occur or are unimportant in a trace gas release. The main phenomena are directly related to the density structure of the dense gas cloud. They are damping of the turbulence level due to stable density stratification within the cloud and alteration of the ambient velocity field due to gravity flow resulting from horizontal gradients in the cloud density. In this paper we address the phenomena of gravity spreading of a denser-than-air cloud dispersing over flat terrain. Specifically, we attempt to interpret the gravity spreading results observed in wind-tunnel studies conducted by CPP Inc.

15264 (UCRL-JC–105271) **Numerical modeling of turbulent dispersion around structures using a particle-in-cell method.** Lee, R.L.; Leone, J.M. Jr. Lawrence Livermore National Lab., CA (USA). 1991. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910659–5: 84. annual meeting and exhibition of the Air and Waste Management Association (AWMA), Vancouver (Canada), 16-21 Jun 1991). Order Number DE91009757. Source: OSTI; NTIS; GPO Dep.

In this paper, a methodology is described wherein two numerical models are exercised in order to predict the turbulent transport and dispersion around a surface-mounted rectangular block. This methodology can be expanded in the future to treat more irregularly-shaped single buildings or clusters of buildings. The calculational procedure which is proposed consists of two separate steps, namely: (1) prediction of the turbulent wind field and (ii) employment of the calculated wind field to drive a transport-dispersion model. It is well known that external flow past non-streamlined bodies is usually very complex, exhibiting separation and reattachment regions, high pressure gradients and turbulence levels, and unsteadiness. The approach employed is to solve the Reynolds-averaged Boussinesq equations with turbulence represented via a k-ϵ model. This particular turbulence model has been applied extensively to many classes of flows including those which are influenced by buoyancy, stratification and rotation effects. It has a good reputation for reliability and is also computationally economical compared to more complex models. Recently, a number of calculations of turbulent flows over surface-mounted cubes which use a k-ϵ turbulence model in conjunction with finite-difference techniques were presented. In contrast, the flow model developed in this paper uses a modified finite element method (FEM). A K-Theory version of this model has been employed to simulate flows which describe the dispersion of heavier-than-air gases and the atmospheric boundary layer. The present model is algorithmically identical to the earlier model except two additional equations were required for the turbulence model and a building-block specification is used to represent structures for computational efficiency. 9 refs., 6 figs.

15265 (UCRL-JC–105277) **Sensitivity of numerical dispersion modeling to explosive source parameters.** Baskett, R.L. (EG and G Energy Measurements, Inc., Pleasanton, CA (USA)); Cederwall, R.T. Lawrence Livermore National Lab., CA (USA). 13 Feb 1991. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48 ;AC08-88NV10617. (CONF-910659–3: 84. annual meeting and exhibition of the Air and Waste Management Association (AWMA), Vancouver (Canada), 16-21 Jun 1991; EGG–10617-411). Order Number DE91009476. Source: OSTI; NTIS; INIS; GPO Dep.

The calculation of downwind concentrations from non-traditional sources, such as explosions, provides unique challenges to dispersion models. The US Department of Energy has assigned the Atmospheric Release Advisory Capability (ARAC) at the Lawrence Livermore National Laboratory (LLNL) the task of estimating the impact of accidental radiological releases to the atmosphere anywhere in the world. Our experience includes responses to over 25 incidents in the past 16 years, and about 150 exercises a year. Examples of responses to explosive accidents include the 1980 Titan 2 missile fuel explosion near Damascus, Arkansas and the hydrogen gas explosion in the 1986 Chernobyl nuclear power plant accident. Based on judgment and experience, we frequently estimate the source geometry and the amount of toxic material aerosolized as well as its particle size distribution. To expedite our real-time response, we developed some automated algorithms and default assumptions about several potential sources. It is useful to know how well these algorithms perform against real-world measurements and how sensitive our dispersion model is to the potential range of input values. In this paper we present the algorithms we use to simulate explosive events, compare these methods with limited field data measurements, and analyze their sensitivity to input parameters. 14 refs., 7 figs., 2 tabs.

15266 (UCRL-JC–106798) **Treatment of denser-than-air releases in an advection-diffusion model: Thermodynamic effects.** Ermak, D.L.; Lange, R. Lawrence Livermore National Lab., CA (USA). Mar 1991. 19p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910659–12: 84. annual meeting and exhibition of the Air and Waste Management Association (AWMA), Vancouver (Canada), 16-21 Jun 1991). Order Number DE91010152. Source: OSTI; NTIS; GPO Dep.

The manufacture, transportation, and use of hazardous chemicals is increasing world-wide, and with this increase has come an increase in the frequency of serious chemical accidents. This situation emphasizes the need for realistic simulations of toxic and dense gas releases for both emergency response and planning purposes. To meet this need, we are modifying an existing advection-diffusion, particle-in-cell type model to include the dispersion effects associated with denser-than-air releases. In this paper, we present the mathematical description of this approach to treating the thermal transport within a cold, heavy gas cloud. A section

briefly describes the overall dense-gas, advection-diffusion, particle-in- cell model. This is followed by a more detailed description of the thermodynamics. First the case of adiabatic mixing is treated, and then the more complex situation with ground heating is considered. Two example problems are also presented to demonstrate the validity of the method. 15 refs., 1 tab.

15267 (VTT-TIED–1181) **Heavy metal emissions in Finland.** Aunela, L. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). LVI-tekniikan Laboratorio); Larjava, K. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Oct 1990. 73p. (In Finnish). Order Number DE91763452. Source: OSTI; NTIS (US Sales Only).

This publication contains information on emission of heavy metals into the atmosphere from Finnish industry, energy production and traffic. The processes in use in Finland that cause heavy metal emissions have been described and the grounds on which emission estimates are based have been presented. In addition to the results of the heavy metal emission inventory, the report also presents international research data on the presence of heavy metals in the flue gases of various processes. There is a short review of the toxicology of heavy metals and an examination, in the light of Finnish studies, of the degree to which the environment has become polluted by heavy metals. Government action aimed at limiting heavy metal emissions in different countries, especially the Federal Republic of Germany, has been studied. The results of the inventory show that in 1988 over a half of Finland's Pb, Cd, Zn, Cu, Ni, Cr, Co and As emissions originated from industrial processes. Only in the cases of V and Hg are the emissions from energy production greater than those from industrial processes. However, the estimated emissions of mercury from industry is uncertain and may in fact be greater than the level estimated here. Ordered in accordance with their emission levels, zinc, copper, vanadium, lead (even when Pb emissions into the atmosphere from traffic are excluded) and nickel are the heavy metals that in Finland are quantitatively the most serious air-pollution offenders. When in addition to the emission level, the vapurization tendencies and toxicity of individual metals are taken into consideration, the significance of As and Hg emissions with respect to the other heavy metals is underlined.

15268 (WINCO–1085) **ICPP environmental monitoring report, CY 1989.** Westinghouse Idaho Nuclear Co., Inc., Idaho Falls, ID (USA). Jan 1991. 59p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-84ID12435. Order Number DE91010127. Source: OSTI; NTIS; INIS; GPO Dep.

Summarized in this report are the data collected through Environmental Monitoring programs conducted at the Idaho Chemical Processing Plant (ICPP) by the Environmental Assurance (EA) Section of the Environmental Compliance and SIS Operations (EC/SIS) Department. Published in response to DOE Order 5484.1, Chap. 3, this report covers the period from December 20, 1988 through December 19, 1989. The ICPP is responsible for complying with all applicable Federal, State, Local and DOE Rules, Regulations and Orders. Radiological effluent and emissions are regulated by the DOE in accordance with the Derived Concentration Guides (DCGs) as presented in DOE Order 5,400.05, and the State of Idaho Maximum Permissible Concentrations (MPCs). The Environmental Protection Agency (EPA) regulates all nonradiological waste resulting from the ICPP operations including all airborne, liquid, and solid waste. The EA Section completed a Quality Assurance (QA) Plan for Environmental Monitoring activities during the third quarter of 1986. QA activities have resulted in the ICPP's implementation of the Environmental Protection Agency rules and guidelines pertaining to the Collection, analyses, and reporting of environmentally related samples. Where no approved methods for analyses existed for radionuclides, currently used methods were submitted for the EPA approval. 17 figs., 11 tabs.

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Refer also to citation(s) 14094, 14191, 14242, 14250, 14262, 14294, 14295, 14323, 14326, 14333, 14334, 14336, 14338, 14340, 14394, 14493, 14687, 14691, 15213, 15222, 15227, 15230, 15232, 15234, 15251, 15253, 15256, 15267, 15268, 15288, 15295, 15299, 15305, 15325, 15328, 15330, 15331, 15384, 15433

15269 (DOE/ER/60557–1) **Exploratory data analysis on data generated in the DOE subsurface microbiology program: Final report.** Meglen, R.R. Colorado Univ., Denver, CO (USA). Center for Environmental Sciences. Jun 1990. 96p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-87ER60557. Order Number DE91007575. Source: OSTI; NTIS; GPO Dep.

The preliminary results from the innovative subsurface microbiology research program indicate that new data on the nature of the link between the geosphere and biosphere have been generated. The diversity of scientific disciplines represented in the subsurface microbiology program reflects the complexity of the system under study. The research carried out by national laboratory and university research scientists is addressing fundamental questions about the abundance of microorganisms and factors controlling microbial activity in the complex subsurface hydrologic and geochemical environment. Long-term implications of this research for mitigating contamination are clear and researchers share the broader objective of linking the basic science with applied work.

15270 (DOE/NV/10630–12) **The Nevada Test Site: Application of in situ monitoring of organics at a jet-a-fuel spill.** Dozier, B.L.; Emer, D.F. Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA). Jan 1991. 62p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC08-89NV10630. Order Number DE91010587. Source: OSTI; NTIS; GPO Dep.

An 18,000 gallon Jet-A fuel spill into the vadose zone at Desert Rock Airport on the Nevada Test Site was the site of a two part study. Part one of this study provided information on site characteristics. Part two of the study provided the opportunity to field test a Volatile Organic Compound (VOC) detection system, refine sampling methodologies, and obtain information on the vadose zone. The field test implemented a detection system designed to monitor the organic phase of a mixed waste monitoring system in use at the Nevada Test Site Area 5 Radioactive Waste Management Site (RWMS) operated by Reynolds Electrical and Engineering Company, Inc. for the Department of Energy. Phase one of the project delineated the areal extent of contamination on the surface. Standard soil gas sampling equipment was used for the shallow soil gas surveys. Phase two incorporated an auger rig and an air hammer rig to determine the depth of contamination. The results of the study yielded approximate information on the volume of soil contaminated, the character of VOCs in the subsurface, and some information on the performance of the VOC detection system in use at the RWMS. 13 refs., 33 figs., 1 tab.

15271 (GSF–17/90) **Decrease of deposited artificial radioactivity in urban environments. Final report.** Jacob, P.; Meckbach, R.; Mueller, H.M.; Meimberg, K. Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz; Bundesministerium fuer Umwelt-, Naturschutz und Reaktorsicherheit, Bonn (Germany, F.R.). Jun 1990. 140p. (In German). Contract BMU St.Sch. 1051. Order Number DE91765001. Source: OSTI; NTIS (US Sales Only); INIS.

The behavior of cesium during the first three years after deposition was investigated with in-situ gamma spectrometry at 48 measuring sites. An evaluation method was developed which allowed determination of retention on asphalt surfaces, the effective depth profile in soils covered with grass, and time factor developments of the gamma dose rate. Two months after deposition, the gamma dose rate on grassy soils amounts to 60% of the dose rate for smooth large-scale surfaces with identical deposition, but without weathering or soil migration. After 3 years this ratio lies at 35%. On asphalt surfaces, however, there was after 2 months only a dose rate of 20% of the dose rate on smooth surfaces without weathering; after 3 years it was only 4%. Environment factors were defined which determined the ratio of dose rates on measuring areas to dose rates on large grassy surfaces. The environment factors are the smaller, the bigger the proportion of asphalt. They are constant as regards the time factor, or they decrease gradually after deposition. Results were approximated analytically. The investigation of tiles showed that there was an activity retention of 30-60% on roofs in Munich following wet deposition of cesium. After 2 years it was still 10-25%. (orig./HP).

15272 (LA–11798-M) **TRACR3D: A model of flow and transport in porous media: Model description and user's manual.** Travis, B.J.; Birdsell, K.H. Los Alamos National Lab., NM (USA). Apr 1991. 112p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91010691. Source: OSTI; NTIS; GPO Dep.

This report describes the TRACR3D computer code, which solves the equations of transient two-phase flow and multicomponent transport in deformable, heterogeneous, sorptive, porous media. Solution is obtained by an implicit finite difference scheme for flow and a semi-implicit or implicit approach for transport. This report describes the equations of the model, defines the numerical solution procedure, and includes a user's guide with sample problems. TRACR3D can be used to study radioactive waste migration from repositories in unsaturated and saturated geology, chemical waste storage, soil water movement, and environmental restoration of chemically polluted soils and groundwaters. 19 refs., 29 figs., 7 tabs.

15273 (NSS/R–206) **Aspects of uranium/thorium series disequilibrium applications to radionuclide migration studies.** Ivanovich, M. (AEA Industrial Technology, Harwell (UK). Process Technology and Instrumentation). United Kingdom Nirex Ltd., Harwell (UK). Nov 1989. 52p. Order Number DE91624427. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of this paper is to consider the contribution which the uranium/thorium series disequilibrium concept can make to understanding the retardation and transport of radionuclides in the far-field of a radioactive waste repository. In principle, naturally occurring isotopes of uranium, thorium and radium can be regarded as geochemical analogues of the divalent radionuclides and multivalent actinides expected to be present in the radioactive waste inventory. The study of their retardation and/or transport in real rock/water systems which have taken place over geological timescales, can make an important contribution to establishing a rational basis for long-term predictive modelling of radionuclide transport required for safety assessments. (author).

15274 (NSS/R–216) **Diffusion under water-saturated conditions in PFA/OPC-based structural concrete.** Harris, A.W. (AEA Industrial Technology, Harwell (UK). Materials and Manufacturing Technology); Nickerson, A.K. United Kingdom Nirex Ltd., Harwell (UK). May 1990. 14p. (AEA-D and R–0014.). Order Number DE91624429. Source: OSTI; NTIS (US Sales Only); INIS.

A substantial proportion of the volume of the UK radioactive waste repository is likely to be composed of materials based on hydraulic cements. This includes the structural components, which are likely to be manufactured from concrete. The mass transport characteristics of dissolved species for a typical structural concrete, based on a mixture of pulverised fuel ash and ordinary Portland cement, have been measured in a water-saturated condition. Both the water permeability and the diffusion parameters (for caesium, strontium and iodide ion and tritiated water diffusion) are low compared to values obtained for other structural concretes. The intrinsic diffusion coefficients for iodide and caesium ions are in the range $2\text{-}5 \times 10^{-14}$ $m^2 s^{-1}$. There is no evidence of significant sorption of any of the diffusants studied. (author).

15275 (NSS/R–224) **Studies of the effects of organic materials on the sorption of tin and radium.** Baston, G.M.N. (AEA Decommissioning and Radwaste, Harwell (UK). Radwaste Disposal Research and Development); Berry, J.A.; Pilkington, N.J. United Kingdom Nirex Ltd., Harwell (UK). Aug 1990. 26p. (AEA-D and R–0033.). Order Number DE91624430. Source: OSTI; NTIS (US Sales Only); INIS.

The effects of the presence of cellulosic degradation products on the sorption of tin and radium on London clay and Caithness flagstones have been studied using the batch sorption and through-diffusion methods. Experimental conditions were chosen to simulate both those expected close to a cementitious repository (pH ≈11) and at the edge of the zone of migration of the calcium plume (pH ≈8). Work was carried out under baseline conditions, in the absence of organic materials with gluconate, acting as a well-characterised simulant of cellulosic degradation products with authentic degradation products. The results have shown that organic degradation products can have a marked effect on the sorption of tin, although the behaviour of radium is little affected. The present work provides further evidence however, of the need to take account of the presence of such organic materials in safety assessment modelling. (author).

15276 (ORNL/TM–11569) **Effects of acidic precipitation on the soil chemistry and bioavailability of aluminum, manganese, and copper.** Environmental Sciences Division, publication no. 3507. Stam, A.C. (Univ. of New York, Syracuse, NY (USA). Coll. of Environmental Science and Forestry); McLaughlin, S.B.; McCormick, J.F. Oak Ridge National Lab., TN (USA). Dec 1990. 281p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010447. Source: OSTI; NTIS; GPO Dep.

Thesis submitted by A.C. Stam to the University of Tennessee.

The effects of acidic precipitation on the soil solution chemistry and bioavailability of Al, Mn, and Cu in soils from spruce-fir and oak-hickory forests were examined in laboratory, greenhouse, and field studies. Simulated acidic precipitation increased LMAl concentrations in the laboratory equilibration and greenhouse studies, but not in the field plot studies in oak-hickory and spruce-fir forests. In all studies, acidic treatments decreased NLMAl concentrations following treatment. These results confirm the hypothesis that acidic precipitation can alter the speciation of soil solution Al. The plant actively influenced soil Al chemistry through rhizosphere acidification and effects on soil organic matter. Loblolly pine and red spruce increased rhizosphere concentrations of total monomeric Al (TMAl) and NLMAl. The pine also increased LMAl concentrations. The plant influenced acidic treatment effects on rhizosphere Al although the effect varied with tree species and soil type. The results confirm the hypothesis that the plant can moderate the effects of acidic precipitation on soil Al chemistry. Acidic treatment only increased Al bioavailability in the greenhouse study of loblolly pine potted in mineral soil with comparatively low exchangeable Ca/Al. There was no evidence of enhanced Al bioavailability under acidic treatment in any of five plant species treated in the field studies or in loblolly pine and red spruce in the greenhouse studies. Mobilization of soil Al versus Ca by acidic treatment appears to be related to the Ca/Al exchange status of a soil. 96 refs., 13 figs., 22 tabs.

15277 (RISO-M–2843) **Data acquisition and application of the soil chemistry model ECCES to forest soil.** Brodersen, K.; Bille-Hansen, J.; Joergensen, K.H.; Hovmand, M.F.; Christiansen, H.; Mackenzie, G.; Solgaard, P. Risoe National Lab., Roskilde (Denmark). Systems Analysis. Dec 1990. 69p. Contract EM-1323/87-12. Order Number DE91763375. Source: OSTI; NTIS (US Sales Only).

EFP-87. Also published in the serie Energiministeriets Energiforskningsprogram. Miljoe og restprodukter.

This final report describes work done on validation of the environmental-effects modelling system ECCES as applied to forest soils. A short description is given of a site in a Danish forest district where monitoring of dry and wet deposition, throughfall, litterfall and soil water composition is continuing since 1985. The present project is a supplement to this field investigation and has covered the following topics: - Investigation of deposition and transport of heavy metals at the forest site. Analyses for Cd, Zn, Pb, etc. in precipitation, throughfall, litterfall and soil-water and in samples of the soil have been made using ICP-MS and other methods. The data are compared with similar data from the literature and are used to estimate the fluxes of heavy metals. The clayey soil is unpolluted and the concentrations in the soil water were mostly below the detection limits. - Characterization of the soil to obtain data needed for the modelling of material fluxes in the system for major as well as minor elements. Cation exchange capacities and function of pH were measured for samples from four soil horizons. Distribution coefficients were determined for the Cd/Ca and Zn/Ca systems at various pH. Fitting with Langmuir or Freundlich expressions is discussed. Anion exchange capacities were low in this relatively high pH soil. Accelerated extraction of soil samples with weak sulphuric acid to obtain indications for the long-term development was also done. - Development of a simple forest model coupled with the existing soil model and testing of the overall system using data from the field investigation and laboratory experiments. Simulation of material fluxes of major components in the

forest system were in reasonable agreement with the measured values, taking some rather coarse assumptions in the model into account. Example calculations simulating soil development over long periods are presented. (AB) 23 tabs., 32 ills., 36 refs.

15278 (UCRL-ID–106599) **Sampling and extraction techniques for organic analysis of soil samples.** Hawley-Fedder, R.; Andresen, B.D. Lawrence Livermore National Lab., CA (USA). 12 Feb 1991. 13p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91010121. Source: OSTI; NTIS; GPO Dep.

A literature search on methods for the sampling, preservation, and sample preparation methods for the analysis of soils for organic compounds has been conducted. The specific CW-related compound classes of interest are relatively nonvolatile, polar species, related to or derived from chemical warfare compounds. Sampling methods and preservation techniques were not widely described in the literature; preservation by refrigeration was the only general method. Sample preparation methods largely involve extraction with an organic solvent. Although some experimenters report using headspace and thermal desorption methods for the analysis of organics in soil, these are confined to use for volatile compound analysis. Recommendations for the development of procedures applicable to a variety of soil types and organic compound classes are included LLNL developed methods for sample work-up are described. 27 refs.

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Refer also to citation(s) 14051, 14094, 14095, 14262, 14308, 14322, 14326, 14338, 14339, 14403, 14404, 14493, 14838, 15222, 15227, 15232, 15234, 15251, 15253, 15256, 15268, 15332, 15333, 15384, 15450, 15451

15279 (ANL/CP–71530) **Disposal of vitrified waste in an unsaturated environment.** Bates, J.K. Argonne National Lab., IL (USA). [1991]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-910435–61: American Nuclear Society (ANS) international high level radioactive waste management conference, Las Vegas, NV (USA), 28 Apr - 3 may 1991). Order Number DE91010278. Source: OSTI; NTIS; INIS; GPO Dep.

An experimental program is described wherein the effect of important independent variables on glass reaction under conditions that may exist for unsaturated storage is examined. The effect of radioactive vs. simulated glasses is being examined in a set of simple and integrated tests. Results through 140 days show that no major differences exist between the two glass types although some trends are being established that need further examination. The effect of SA/V was examined in preliminary tests done at 10, 50, and 100 m^{-1}. Analysis of the reacted glass structure indicated that as the SA/V changed, the assemblage of crystalline phases that formed on the reacted glass varied and the process by which the glass structure reacted changed. Finally, the effect of radiation on glass reactivity is being studied. For each variable studied, tests are in progress that will provide information to support startup of the glass processing facilities and licensing of a repository. 16 refs., 2 figs., 3 tabs.

15280 (BNL–45883) **ISHTAR: Inner shelf transport and recycling in the Bering/Chukchi Seas: 1985–1989 moored Chlorophyll und a fluorescence, temperature, and beam attenuation measurements.** Medeiros, W.H.; Wirick, C.D. Brookhaven National Lab., Upton, NY (USA). Feb 1991. 199p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. Order Number DE91010360. Source: OSTI; NTIS; GPO Dep.

ISHTAR is a multi-disciplinary, multi-university ecosystem study designed to test the hypothesis that interannual changes of atmospheric forcing on water transport through the Bering Strait result in a two-fold to four-fold difference in: (1) the flux of nutrients from the shelf break of the northwestern Bering Sea; (2) the primary production north of St. Lawrence Island; (3) the burial of carbon in Chukchi Sea sediments; (4) the amount of energy passed up the food web; and finally (5) the chemical properties of the Arctic Ocean water transported south across the Greenland-Scotland ridge system. The northern Bering Sea extending from St. Lawrence Island to Bering Strait was chosen as the site for studying phytoplankton populations and their role in transporting organic carbon. The authors major scientific responsibilities in the ISHTAR program are to: (1) provide phytoplankton boundary conditions for models constructed by other components; (2) obtain time series suitable for identifying interannual variations in phytoplankton standing stocks; and (3) identify the dominant time and length scales of the phytoplankton distributions. In addition, they construct, maintain, calibrate, and deploy the moored fluorometers used to make the required measurements. 3 refs., 6 figs., 12 tabs.

15281 (BSE-PROC–26) **Activities of the commission 1987: Including the Ninth Meeting of the Commission held in Helsinki 15-19 February 1988.** Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1988. 174p. Order Number DE91763459. Source: OSTI; NTIS (US Sales Only).

The activities of the Commission during 1987 such as the meetings of the Scientific Technological Committee (STC), the Maritime Committee (MC) and the Combatting Committee (CC) are summarized. The administration of the Commission during 1987 is reported. The Commission held its ninth meeting in Helsinki 15-19 February 1988. The declaration on the protection of the marine environment of the Baltic Sea area adopted on 15 February 1988 in Helsinki by the Ministers responsible for the environmental protection in the Baltic Sea States is included in the report. The list of the recommendations passed during 1988 is published in the appendix.

15282 (BSE-PROC–28) **Reception of wastes from ships in the Baltic Sea area - a MARPOL 73/78 special area.** Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1989. 86p. Order Number DE91763433. Source: OSTI; NTIS (US Sales Only).

The present booklet 'Reception of Wastes from Ships in the Baltic Sea Area - MARPOL 73/78 Special Area', First Edition, April 1989, is the result of the task given to the maritime Committee. It consists of nine chapters of which Chapter 1 contains general information on the Baltic Sea Area, the Helsinki Convention and its relation to MARPOL 73/78. Chapters 2-8 are national chapters containing pertinent information on reception of wastes from ships in the ports of the seven Coastal States in the Baltic Sea Area (Denmark, Finland, the German Democratic Republic, the Federal Republic of Germany, Poland, Sweden and the USSR). Chapter 9 contains an inventory of reception services in the Baltic Sea Area. The booklet addresses those within the shipping industry who, due to their shipping related activities in the Baltic Sea Area, need detailed information on the many different aspects relating to reception of wastes from ships. It is of great importance to the Coastal States of the Baltic Sea Area that any inadequacy of reception facilities/arrangements be reported to them, and the users of this booklet are urged to use the reporting formats attached to Chapter 1 whenever any alleged inadequacy is experienced. The filled-in formats should be submitted to the appropriate national administration in the reporter's country for evaluation and further information of the Coastal State in question, if the allegation is considered justified.

15283 (BSE-PROC–29) **Activities of the Commission 1988: Including the Tenth Meeting of the Commission held in Helsinki 14-17 February 1989.** Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1989. 101p. Order Number DE91763460. Source: OSTI; NTIS (US Sales Only).

The activities of the Commission during 1988 such as the meetings of the Scientific-Technological Committee (STC), the Maritime Committee (MC) and the Combatting Committee (CC) are summarized. The administration of the Commission during 1988 is reported. The Commission held its tenth meeting in Helsinki 14-17 February 1989. The Commission considered and decided upon matters within the technological, scientific, maritime and legal fields related to the Baltic Sea as well as upon matters related to cooperation in combatting pollution on the sea. The preparatory work had been done during the intersessional period by the three subsidiary bodies (STC, MC and CC) and several working groups as well as

ad hoc working groups and informal expert meetings. All Recommendations adopted by the tenth meeting of the Commission are attached to this report.

15284 (BSE-PROC–33) **Activities of the Commission 1989: Including the Eleventh Meeting of the Commission held in Helsinki 13-16 February 1990.** Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1990. 68p. Order Number DE91763461. Source: OSTI; NTIS (US Sales Only).

The activities of the Commision during 1989 such as the meetings of the Scientific-Technological Committee (STC), the Maritime Committee (MC) and the Combatting Committee (CC) are summarized. The administration of the Commission during 1989 is reported. The Commission held its eleventh meeting in Helsinki 13-16 February 1990. A list of the recommendations passed during 1989 and 1990 is published in the appendix of this report.

15285 (BSE-PROC–34) **Study of the risk for accidents and the related environmental hazards from the transportation of chemicals by tankers in the Baltic Sea area.** Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. May 1990. 39p. Order Number DE91763434. Source: OSTI; NTIS (US Sales Only).

The study presented in this document has been conducted to identify the transportation patterns for chemicals carried in bulk in the Baltic Sea Area and the related risks for outflow and potential hazards to the marine environment. The study has been performed under the auspices of the Combatting Committee of the Helsinki Commission in close cooperation between all the Baltic Sea States and forms part of a joint work in development of necessary response methods for chemical spills in the Baltic Sea Area. The work has included a thorough collection of transportation data for chemicals in bulk in all Baltic Sea ports during the entire year of 1987 and elaboration of these data for the development of transportation patterns. Information about applicable ship standard and the related accident risks has been applied to the transportation pattern, enabling estimation of the expected rate of accidents with outflow and their geographical distribution, the size of the significant outflow, the substances likely to constitute the highest risk for accidental outflow and the elated hazard to the marine environment. liquid chemicals carried in packaged form are not included in this study, nor solid chemical substances carried in bulk or in packaged form. This report describes briefly the results of the investigations and the model used for the calculation of accidental risks and the related outflow of chemicals.

15286 (BSE-PROC–35A) **Second periodic assessment of the state of the marine environment of the Baltic Sea, 1984-1988; general conclusions.** Gerlach, S.A. (ed.). Baltic Marine Environment Protection Commission, Helsinki (Finland). Helsinki Commission. 1990. 29p. Order Number DE91763435. Source: OSTI; NTIS (US Sales Only).

The present assessment of the Baltic Sea Area concerning primarily the years 1984-1988 deals mainly with observations made in the open Baltic Sea and consequently, the statements do not reflect findings in coastal areas, which will be assessed separately. Due to the ban in the use of some harmful substances, positive changes were observed; DDT and PCB concentrations in biota have decreased since the 1970s and are now on a lower and steady level, although comparable data on herring indicate that the levels are still higher in the Baltic than in the Skagerrak area. After the ban on technical hexachlorocyclohexane (HCH), the decrease of α - HCH concentrations in water is still continuing. COncentrations of organochlorine residues in fish from the Baltic Proper are still 3 to 10 times higher than in fish from around the Shetland Islands. Among the 'new contaminants', there has been an increasing number of organic substances identified which are potentially harmful to the environment. Trace element concentrations in fish and shellfish have not changed remarkably since the early 1980s. Generally, it can be stated that mercury concentrations in biota do not significantly differ now from those in the North Sea and the North-East Atlantic. Sallinity continued to decrease mainly due to lack of major inflows of highly saline water from the North Sea during the last 13 years. The area with insufficient oxygen conditions for macrofauna (about 70 000 km^2 with less than 2ml/l oxygen in bottom water) has fluctuated in extent from year to year, but has not increased for 25 years in the Central Baltic Sea and the Gulf of Finland.

15287 (CONF-910278–5) **Screening of groundwater for aromatics by synchronous fluorescence.** Gammage, R.B. (Oak Ridge National Lab., TN (USA)); Haas, J.W. III; Allen, T.M. Oak Ridge National Lab., TN (USA). [1991]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 2. international symposium on field screening methods for hazardous wastes and toxic chemicals; Las Vegas, NV (USA); 12-14 Feb 1991. Order Number DE91009563. Source: OSTI; NTIS; GPO Dep.

Pollution by petroleum, oil, and lubricants is a ubiquitous national problem. The aromatic constituents contained in these pollutants can generally be induced to fluoresce. The problem of identifying individual compounds, in what is often a complex mixture of fluorescing constituents, can be enhanced by resorting to a technique known as synchronous fluorescence (SF). 5 refs., 2 figs., 1 tab.

15288 (CONF-9106120–1) **Groundwater phenomena and the theory of mixtures.** Lee, D.W. (Oak Ridge National Lab., TN (USA)); Wineman, A.S. Oak Ridge National Lab., TN (USA). [1991]. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From Recent advances on mechanics of structure continua ASME applied mechanics conference; Columbus, OH (USA); 16-19 Jun 1991. Order Number DE91007677. Source: OSTI; NTIS; GPO Dep.

The phenomena of groundwater motion and the recent developments in the Theory of Mixtures are reviewed. Comparisons of these results with those from classical theory are presented. Phenomena of interest that are not well explained are discussed and the potential of the Theory of Mixtures in addressing these phenomena is presented. 16 refs.

15289 (DOE/BP/14383–4) **Salmon River habitat enhancement: Annual report - 1989.** Rowe, M. (Shoshone-Bannock Tribal Fisheries Dept., Fort Hall Reservation, ID (USA)); Spaulding, S.; Gunderman, J.M.; Bacon, K. USDOE Bonneville Power Administration, Portland, OR (USA). Div. of Fish and Wildlife; Shoshone-Bannock Tribal Fisheries Dept., Fort Hall Reservation, ID (USA). Apr 1989. 194p. Sponsored by USDOE, Washington, DC (USA). DOE Contract BI79-84BP14383. Order Number DE91009704. Source: OSTI; NTIS; GPO Dep.

This project was funded by the Bonneville Power Administration (BPA). The annual report contains three individual subproject papers detailing tribal fisheries work completed during the summer and fall of 1989. Subproject 1 contains summaries of evaluation/ monitoring efforts associated with the Bear Valley Creek, Idaho enhancement project. Subproject 2 contains an evaluation of the Yankee Fork of the Salmon River habitat enhancement project. This report has been sub-divided into two parts: Part 1; stream evaluation and Part 2; pond series evaluation. Subproject 3 concerns the East Fork of the Salmon River, Idaho. This report summarizes the evaluation of the project to date including the 1989 preconstruction evaluation conducted within the East Fork drainage. Dredge mining has degraded spawning and rearing habitat for chinook salmon and steelhead trout in the Yankee Fork drainage of the Salmon River and in Bear Valley Creek. Mining, agricultural, and grazing practices degraded habitat in the East Fork of the Salmon River. Biological monitoring of the success of habitat enhancement for Bear Valley Creek and Yankee Fork are presented in this report. Physical and biological inventories prior to habitat enhancement in East Fork were also conducted. Four series of offchannel ponds of the Yankee Fork are shown to provide effective rearing habitat for chinook salmon. 45 refs., 49 figs., 24 tabs.

15290 (DOE/BP/17579–2) **Anadromous fish habitat enhancement for the Middle Fork and Upper Salmon River: Annual report - 1988.** Andrews, J. Forest Service, Ogden, UT (USA). Intermountain Region. Jan 1990. 33p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AI79-84BP17579. Order Number DE91009706. Source: OSTI; NTIS; GPO Dep.

The wild and natural salmon and steelhead populations in the Middle Fork and Upper Salmon River are at a critical low. Habitat enhancement through decreasing sediment loads, increasing vegetative cover, removing passage barriers, and providing habitat diversity is imperative to the survival of these specially adapted

fish, until passage problems over the Columbia River dams are solved. Personnel from the Boise and Sawtooth National Forests completed all construction work planned for 1988. In Bear Valley, 1573 feet of juniper revetment was constructed at eleven sites, cattle were excluded from 1291 feet of streambanks to prevent bank breakdown, and a small ephemeral gully was filled with juniper trees. Work in the Upper Salmon Drainage consisted of constructing nine rock sills/weirs, two rock deflectors, placing riprap along forty feet of streambank, construction of 2.1 miles of fence on private lands, and opening up the original Valley Creek channel to provide spring chinook passage to the upper watershed. A detailed stream survey of anadromous fish habitat covering 72.0 miles of streams in the Middle Fork Sub-basin was completed. 11 refs., 10 figs., 5 tabs.

15291 (DOE/BP/64344–2) **Augmented fish health monitoring for Washington Department of Wildlife: Annual report 1988.** Gearheard, J. (Washington State Dept. of Wildlife, Olympia, WA (USA)); Kerwin, J.; Roberts, S.; Bolding, B. USDOE Bonneville Power Administration, Portland, OR (USA). Div. of Fish and Wildlife; Washington State Dept. of Wildlife, Olympia, WA (USA). [1988]. 31p. Sponsored by USDOE, Washington, DC (USA). DOE Contract BI79-86BP64344. Order Number DE91009709. Source: OSTI; NTIS; GPO Dep.

The augmented fish health monitoring project is funded by the Bonneville Power Administration with the mandate to collect fish health data on anadromous fish stocks of the Columbia River Basin in a standardized manner. The project began in 1986 and the data reported here was collected in the third year. This segment of the project was carried out by the Washington Department of Wildlife and summarizes fish health findings at anadromous game hatcheries in Washington State operated by the BPA. Information gathered to date has provided impetus to alter facility design and management practices for improved fish health through prevention. Treatment efficacy can be better assessed due to the monthly monitoring of fish stocks and insight is being gained into disease prevention and control. The ultimate goal, of course, is to improve fish health for better survival in the wild. Tagged returns at index hatcheries within this project area will indicate the impact of improving fish health on providing greater adult returns as well as an improved product for the fishery. 2 refs., 3 figs., 15 tabs.

15292 (DOE/EA–0496-Vol.1) **Surface Water Interim Measures/Interim Remedial Action Plan/Environmental and Decision Document, South Walnut Creek Basin, Operable Unit No.2: Volume 1, Text: Final.** EG and G Rocky Flats, Inc., Golden, CO (USA). Rocky Flats Plant. 8 Mar 1991. 190p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91010636. Source: OSTI; NTIS; INIS; GPO Dep.

Water quality investigations have identified the presence of volatile organic compound (VOC) and radionuclide contamination of surface water at the Rocky Flats Plant (RFP). The subject interim Measures/Interim Remedial Action Plan/Environmental Assessment (IM/IRAP/EA) addresses contaminated surface water in a portion of the South Walnut Creek drainage basin located within an area identified as Operable Unit No. 2 (OU 2). There is no immediate threat to public health and the environment posed by this surface water contamination. The affected surface water is contained within the plant boundary by existing detention ponds, and is treated prior to discharge for removal of volatile contaminants and suspended particulates to which radionuclides, if present, are likely to absorb. However, there is a potential threat and the Department of Energy (DOE) is implementing this Surface Water IM/IRAP at the request of the US Environmental Protection Agency (EPA) and Colorado Department of Health (CDH). Implementation of the Surface Water IM/IRA will enhance the DOE's efforts towards containing and managing contaminated surface water, and will mitigate downgradient migration of contaminants. Another factor in implementing this IM/IRA is the length of time it will take to complete the investigations and engineering studies necessary to determine the final remedy for OU 2. 44 refs., 23 figs., 14 tabs.

15293 (DOE/NV/10384–31) **Assessment of the Nevada Test Site monitoring well system.** Russell, C.E. Nevada Univ., Reno, NV (USA). Desert Research Inst. Mar 1991. 93p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC08-85NV10384. Order Number DE91010370. Source: OSTI; NTIS; INIS; GPO Dep.

The Department of Energy's (DOE), Office of Environment, Safety and Health requested the Desert Research Institute (DRI) to conduct an assessment of the current monitoring well system on the Nevada Test Site (NTS), and to design a groundwater characterization plan for the NTS. In response to DOE's request, the DRI prepared a four phase monitoring plan. This report is the summary of Phase 1, reconnaissance of the current monitoring system. The data in this report include well construction, lithology, the location of each well in the current hypothesis of the groundwater flow field, as well as its location with respect to underground nuclear testing areas. In addition, the chemical constituents and tritium record for these wells are presented. Preliminary classification of the existing monitoring wells is attempted in accordance with the requirements set forth in the Resource Conservation and Recovery Act of 1976. These classifications are preliminary owing to the resolution density of hydrogeologic data on the NTS, which are quite sparse. 36 refs., 13 figs., 4 tabs.

15294 (DOE/NV/10845–7) **Evaluation of groundwater monitoring at offsite nuclear test areas.** Chapman, J.B.; Hokett, S.L. Nevada Univ., Reno, NV (USA). Desert Research Inst. Mar 1991. 88p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC08-90NV10845. Order Number DE91009218. Source: OSTI; NTIS; GPO Dep.

Groundwater quality has been monitored at nuclear test sites distant from the Nevada Test Site as part of the Long-Term Hydrologic Monitoring Program (LTHMP) since 1972. Separate reports describing the monitoring programs recommended by the US Department of Energy (DOE) Hydrologic Program Advisory Group were issued by the DOE for most of the offsite areas during the early 1980s, and the analytical results from the LTHMP have been regularly reported by the US Environmental Protection Agency (EPA), but there has been little else published about the program. The LTHMP has continued to demonstrate the safety of drinking water supplies near the offsite areas and there have been very few modifications to the program initially mandated by the DOE in 1972. During this time, however, there have been many changes in the fields of hydrogeology and environmental monitoring. In 1988, the DOE requested the Desert Research Institute to perform a critical review of the LTHMP in light of the many technical and regulatory advances in groundwater monitoring in recent years. This report presents an evaluation of the offsite groundwater monitoring program and evaluations specific to the monitoring networks at each of the eight offsite test areas. Discussion of the overall program is presented first, followed by site-specific recommendations. References follow each section for the convenience of readers interested in particular sites. 63 refs., 27 figs., 1 tab.

15295 (DOE/SR/18035–P-H2) **The Groundwater Monitoring Program at the Savannah River Site.** Westinghouse Savannah River Co., Aiken, SC (USA). Oct 1990. 293p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. (WSRC-RP–89-889). Order Number DE91009822. Source: OSTI; NTIS; GPO Dep.

This report summarizes the status of the Groundwater Monitoring Program conducted at the US Department of Energy's Savannah River Site (SRS). The report details the history and technical background of SRS's program, identifies practices which have resulted in groundwater impacts, explains the regulatory controls on the program, and summarizes the status of the major program elements. The purpose of the Groundwater Monitoring Program is to protect human health, safety, and the environment, while maintaining compliance with environmental statutes and regulations. The report is organized sequentially. Background and history of the SRS monitoring program is presented in Chapter 2. Program requirements are defined in Chapter 3, including a summary of applicable regulatory requirements. The report includes a status report in Chapter 4, which describes regulatory and monitoring sites as well as technical and research groundwater monitoring activities. The report concludes in Chapter 5 with a summary of planned activities and their relationship to DOE's Environmental Restoration and Waste Management Five Year Plan. 60 refs., 14 figs., 9 tabs.

15296 (DPST–88-605) **Radioactive effluents in Savannah River: Summary report for 1987.** Winn, W.G. Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab. 3 Jun 1988. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035 ;AC09-76SR00001. Order Number DE91009304. Source: OSTI; NTIS; INIS; GPO Dep.

The startup of Plant Vogtle in 1987 has required additional scrutiny in radiometric appraisals of the Savannah River. The Environmental Technology Division conducted radiometric environmental studies of Plant Vogtle, prior to its startup in April 1987. The continuation of these studies identified Co-58 effluents in the Savannah River, caused by controlled releases from Vogtle in May and October of 1987. Smaller amounts of other neutron-activated radionuclides were also observed with the Co-58; however, all concentrations were several orders of magnitude below the DOE guide values. The ETD river measurements correlated well with effluent release data provided by Vogtle. During 1987, radioactive effluents in the Savannah River increased due to Vogtle operations; however, all radionuclide concentrations remained well below DOE guides for drinking water. The Vogtle effluents were dominated by Co-58, which had a maximum of 17 pCi/L observed during the controlled October release. Smaller amounts of Cr-51, Mn-54, Co-57, Fe-59, Co-60, Nb-95, and Zr-95 were also observed in the effluents. Tritium and Cs-137 were routinely monitored but displayed no major variations from prior studies. 5 refs., 4 figs., 8 tabs.

15297 (DTH-ISVA-Series Paper–49) **Immiscible multi-phase flow in porous media.** Hoest-Madsen, J. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Inst. for Stroemningsmekanik og Vandbygning. Dec 1989. 171p. Order Number DE91763373. Source: OSTI; NTIS (US Sales Only).

Immiscible multi-phase flow in porous media was investigated by laboratory experiments and numerical simulations. The experimental results support the applicability of analytical closed-form expressions representing the hydraulic relations and a scaling procedure in which the interfacial tensions are used to derive scaling factors. The migration of oil in the unsaturated and saturated groundwater zone was simulated by transient flow of water, oil, and air in a groundwater flow flume. In order to measure the water, oil, and air saturations simultaneously, a dual gamma attenuation technique was used. The theoretical background and calibration procedures for the technique are outlined. With the assumption of spatial uniformity of porosity and permeability the technique makes it possible to compare and verify numerical simulations with three-phase flow experiments in the laboratory. The results were successfully used as validation data for a comprehensive black oil reservoir model, ECLIPSE. Effects from hysteresis in the hydraulic relations were investigated numerically by simulating the performed two-dimensional three-phase flow experiments using hysteretic hydraulic relations. The hysteresis flattens the oil saturations during migration through the unsaturated zone, but has very little effect on the shape of the residual oil bodies. Influence on multi-phase flow by heterogeneity was investigated. A semi-analytical oil flow model for unconfined aquifers was further developed, in addition to a similar model for confined aquifers. They are capable of calculating the spreading of immiscible oil in homogeneous and isotropic porous media. Although the two semi-analytical models do not directly consider transport of soluble and volatile components, knowledge of the free oil spreading can be the basis for calculations of soluble and volatile transport. (AB) 89 refs.

15298 (EGG-ESQ–9293) **Nonradiological Liquid-Effluent Monitoring Program: FY 1990 third-quarter report.** Wright-Peterson, L.J.; Meachum, T.R. EG and G Idaho, Inc., Idaho Falls, ID (USA). Oct 1990. 187p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. Order Number DE91010086. Source: OSTI; NTIS; GPO Dep.

A monitoring program for nonradioactive parameters and poilutants in liquid effluents was initiated in October 1985 for facilities operated by EG&G Idaho, Inc., for the US Department of Energy (DOE) at the Idaho National Engineering Laboratory (INEL). Monitoring results for 12 liquid effluent streams from third quarter fiscal year 1990 (April 1990 through June 1990) are presented. 6 tabs.

15299 (GKSS–90/E/17) **Analysis of the sediments of a freshwater tidal flat of the Elbe river estuary.** Jacob, M. (GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Chemie); Krebs, S. GKSS-Forschungszentrum Geesthacht GmbH, Geesthacht-Tesperhude (Germany, F.R.); Hamburg Univ. (Germany, F.R.). Fachbereich 15 - Geowissenschaften. 1990. 235p. (In German). Order Number DE91764471. Source: OSTI; NTIS (US Sales Only).

Under the Special Research Project 327 'Interaction between abiotic and biotic processes in the Tide-Elbe' the freshwater tidal flat at the test site Asseler Sand was mapped, sedimentologically examined and its structure was characterized. On surface samples and sediment cores the parameters grain size composition, water content, heat loss, clay mineral composition and heavy metal load were determined. On undisturbed sediment samples from different depths the hydrological parameters porosity, density and permeability were examined. By detailed description of bedding structures, the interpretation of depth charts as well as the dating by anthropogenic heavy metals, information about the mode of sediment formation and the deposition rate was obtained. (orig.) With 84 figs., 28 tabs.

15300 (INIS-mf–12806, pp. 340-349) **Studies on isotope hydrology of Korea.** Ahn, J.S. (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)); Han, J.S.; Lee, C.K. Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

An environmental isotope investigation of the groundwater stored in the shallow alluvium and underlying crystalline rock aquifer, and of the interaction between surface water and ground water, has been undertaken in the karst area of the Han River valley. The data collected have confirmed that groundwater in the metropolitan area is recharged by the river water and that the groundwater in the non-urbanized region is replenished by infiltrating precipitation. Crystalline rock aquifers that occur as faults, fracture zones and other forms of secondary porosity are recharged by the shallow groundwater from overlying unconsolidated alluvial deposits. The groundwater that fills wells in limestone is of the same origin as the stream water. This indicates that water flowing in the stream channel is percolating through or into solution with the limestone, forming a type of ground water. This water then appears further downstream as a spring. Isotope analysis of the groundwater at Cheju Island has proven helpful in interpreting the general hydrologic and hydrogeologic relations and in developing a model of the groundwater flow system in the permeable volcanic rocks of the island. The ground water's tritium and stable isotope ($D\text{-}O^{18}$) level provided a basis for modeling the groundwater flow regime.

15301 (INIS-mf–12806, pp. 350-352) **Use of radioisotopes as tracers in geothermal wells.** Leopando, L. (Philippine Atomic Energy Commission, Diliman, Quezon City (Philippines)); Domondon, D.B.; Abaya, S.L.; Santos, R.L.; Barz, J.S. Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Successful utilization of geothermal fields for electric power generation depends on the response of the reservoir to extensive exploitation. For geothermal fields in the early phases of development, only a limited discharge history is available. The site under investigation, the Tongonan geothermal field, is one of these. The drilling program was initiated in 1976 and more than 30 drillings have resulted in producing wells with an average output of 10.5 MW. The minimum anticipated available capacity is 750 MW. To determine large scale response of this reservoir to a sustained withdrawal of geothermal fluids over 25 years, a field drawdown test has been planned. This involves discharging a number of wells simultaneously over a period of one or two years. Radioisotope techniques have been incorporated into the tests to determine if horizontal permeability connections exist between two wells, and to

trace the subsurface movements of reinjected spent fluid. The radioactive tracer, 20 GBq iodine 131, is introduced into wells using a modified Klyen downhole sampler.

15302 (INIS-SU–231, pp. 87-91) **Tritium in atmospheric precipitations, rivers and seas in the USSR.** Vakulovskij, S.M.; Gasilina, N.K.; Katrich, I.Yu.; Malakhov, S.G.; Roslyj, E.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

13 refs.; 2 tabs. KRB-IV. Chast' 1.

Regularities of tritium distribution in atmospheric precipitations, rivers, seas in the USSR are considered. It is shown that annual average tritium concentrations depend on geographical location, time and also on carried out nuclear tests. Tritium concentration in rivers is also defined by its concentrations in atmospheric precipitations and underground waters, feeding rivers. Tritium concentration in seas also depends on the sea depth and water exchange. 13 refs.; 2 tabs.

15303 (INIS-SU–231, pp. 92-96) **Transfrontier transfer radioactive wastes from West-European radiochemical plants in seas of the USSR.** Vakulovskij, S.M.; Nikitin, A.N.; Chumichev, V.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

11 refs.; 1 tab. KRB-IV. Chast' 1.

Results of systematic investigations begun in 1977 concerning assessment of the effect of transfrontier transfer of contaminated waters on radiation situation in the USSR seas: Baltic, Barents, Kara and Greeenland one, are presented. Information on ^{90}Sr, ^{137}Cs, ^{134}Cs is given. Measurements in the Greenland, Barents and Kara Seas permit to suggest that radioactive wastes, located in these seas are transferred to other regions of the Arctic Ocean. 11 refs.; 1 tab.

15304 (IVL-B–989) **Separation of complex bound copper from waste water with reverse osmosis.** Ekengren, Oe.; Bergstroem, R. Institutet foer Vatten- och Luftvaardsforskning, Stockholm (Sweden). Oct 1990. 30p. (In Swedish). Order Number DE91763545. Source: OSTI; NTIS (US Sales Only).

Complex bound copper exist in many rinsing and waste waters from e.g. the printed circuit board industry. These compounds are difficult to separate with chemical precipitation at the individual companies. This means that the copper compounds pollute the sludge from the municipal sewage treatment plants. Because of this, the allowed limit for discharge of copper has been lowered. IVL have investigated the possibility of separating the rinsing waters containing copper from three different industries with reverse osmosis. The experiments has been conducted both in the laboratory and in the field. The pilot scale experiments have been performed for more than 1000 hours and for most of the time, the effluents have contained less than the new allowed limit for copper (0.5 mg/l). This means that the water can be released to the municipal sewage treatment system or reused as rinsing water. The flux has been approx 20-30 l/m^2, at a volume reduction of 40-100 times. The experiments show that mixing different sewage streams should be avoided since foulings and disturbances can occur. The material balance shows that 98% of the copper can be separated. The copper that is separated out can either be brought back into the process or reclaimed as pure metal through electrolysis treatment. The treatment cost are 120 SEK/m^3. If the copper is reclaimed and the treated water recycled, the treatment cost can be reduced to approx 80 SEK/m^3. When treating large volumes, the cost can be further reduced.

15305 (LBL–29898) **Preliminary environmental investigations at the Lawrence Berkeley Laboratory.** Javandel, I. Lawrence Berkeley Lab., CA (USA). Nov 1990. 147p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010234. Source: OSTI; NTIS; GPO Dep.

A baseline ecology study was performed in 1986 for the development of East Canyon at Lawrence Berkeley Laboratory. Samples were analyzed from soil, groundwater, surface water, and vegetation, revealing low levels of chlorinated hydrocarbons from two horizontal flowing drains from the adjacent area. Because of the persistence of these levels of chemical concentration in the effluent water from these two hydraugers, and the observation of some contamination elsewhere in the area in 1989, LBL submitted a proposal to DOE for a sitewide environmental characterization and monitoring program. Meanwhile, during Fiscal Year 1990, LBL carried out a preliminary investigation. The results of this preliminary environmental investigation are presented. 9 refs., 38 figs., 6 tabs. (FL)

15306 (LBL-PUB–685) **Science Consortium annual report, FY1990.** Lawrence Berkeley Lab., CA (USA). [1991]. 32p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91009798. Source: OSTI; NTIS; GPO Dep.

This report synthesizes the results of collaborative research efforts by Lawrence Berkeley Laboratory (LBL), Berkeley, California; Jackson State University (JSU), Jackson, Mississippi; and the Ana G. Mendez Educational Foundation (AGMEF), Rio Piedras, Puerto Rico for FY 1990. The number and quality of interactions among faculty, staff, and students at the three institutions have been at their highest level to date. The Science Consortium funded three joint research projects which dealt with the environment, computer science, and biotechnology/molecular biology. The Computer Database and Models for Human Hemoglobin Genes and Their Functions project will construct a computer database and computer model encompassing the structural, functional and clinical aspects of human hemoglobins produced as as result of mutations in globin genes. The Bioassay of Environmental Toxins project is developing sensitive bioassay for the detection of hazardous agents in the marine environment. The Cloud Chemistry focuses on the importance of aerosol particles in cloud physics. (FL)

15307 (NIVA-O–89210) **Critical loads for surface waters: Chemical criteria for inputs of strong acids.** Henriksen, A.; Lien, L.; Traaen, T.S. Norsk Inst. for Vannforskning, Oslo (Norway). Sep 1990. 48p. Order Number DE91763502. Source: OSTI; NTIS (US Sales Only).

Chemical criteria have been established for the critical loads of strong acids to surface waters in Norway. A complete set of data is available for all counties with the exception of North Troendelag, Nordland, Troms and Finnmark excluding the municipality of South Varanger. Colored maps for southern Norway have been prepared showing quantitative critical loads for acidic components, areas where the critical load is exceeded, and the regional runoff (export) of sulfur. At present, the critical load has been exceeded in approximately 30% of southern Norway. The most affected counties are East Agder, West Agder, and Rogaland. 10 refs., 17 figs., 2 tabs.

15308 (NMP-RMT–900326) **Chronic toxicity evaluation of the Savannah River Site DETF discharges and three locations on Tims Branch: Final report.** Westinghouse Savannah River Co., Aiken, SC (USA); Shealy Environmental Services, Inc., Columbia, SC (USA). Oct 1990. 197p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC09-89SR18035. Order Number DE91009372. Source: OSTI; NTIS; INIS; GPO Dep.

Chronic toxicity tests with Ceriodaphnia dubia were conducted June 6–August 1, 1990, on the Savannah River Site M-Area supernate discharge effluent (M-004), the A-014 effluent discharge with and without DETF process flow, and for stream samples collected in Tims Branch upstream and downstream from A-014. A secondary objective of the study was to determine what DETF flow rate would not cause instream impact to the aquatic community. 2 figs., 68 tabs.

15309 (ORNL/CDIAC–41) **Indian Ocean radiocarbon: Data from the INDIGO 1, 2, and 3 cruises.** Sepanski, R.J. Oak Ridge

National Lab., TN (USA). Jan 1991. 188p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. (NDP–036). Order Number DE91010436. Source: OSTI; NTIS; INIS; GPO Dep.

Contributed by H. Göte Östlund and Charlene Grall, Rosenstiel School of Marine and Atmospheric Science, Univ. of Miami, Miami, Florida.

This document presents ^{14}C activities (expressed in the internationally adopted $\Delta^{14}C$ scale) from water samples taken at various locations and depths in the Indian and Southern oceans through the Indien Gaz Ocean (INDIGO) project. These data were collected as part of the INDIGO 1, INDIGO 2, and INDIGO 3 cruises, which took place during the years 1985, 1986, and 1987, respectively. These data have been used to estimate the penetration of anthropogenic CO_2 in the Indian and Southern oceans. The document also presents supporting data for potential temperature, salinity, density (sigma-theta), $\delta^{13}C$, and total CO_2. All radiocarbon measurements have been examined statistically for quality of sample counts and stability of counting efficiency and background. In addition, all data have been reviewed by the Carbon Dioxide Information Analysis Center and assessed for gross accuracy and consistency (absence of obvious outliers and other anomalous values). These data are available free of charge as a numeric data package (NDP) from the Carbon Dioxide Information Analysis Center. The NDP consists of this document and a magnetic tape containing machine-readable files. This document provides sample listing of the Indian Ocean radiocarbon data as they appear on the magnetic tape, as well as a complete listing of these data in tabular form. This document also offers retrieval program listings, furnishes information on sampling methods and data selection, defines limitations and restrictions of the data, and provides reprints of pertinent literature. 13 refs., 4 tabs.

15310 (ORNL/M–1148, pp. 1.1-1.6) **Introduction and background.** Baker, J.; Gherini, S.; Munson, R. Oak Ridge National Lab., TN (USA); Adirondack Lakes Survey Corp., Ray Brook, NY (USA). 1990. In *Adirondack lakes survey: A interpretive analysis of fish communities and water chemistry, 1984–1987.* 431p. Order Number DE91005645. Source: OSTI; NTIS.

Much of the debate in the United States concerning the effects of acidic deposition on surface water chemistry and fish communities has focused on the Adirondack Region of New York State. To better characterize the chemical and biological status of Adirondack lakes, the Adirondack Lakes Survey Corporation (ALSC) was formed as a cooperative effort of the New York State Department of Environmental Conservation (NYSDEC) and the Empire State Electric Energy Research Corporation (ESEERCO). Between 1984 and 1987, the ALSC surveyed 1469 lakes within the Adirondack ecological zone. The results from this survey are described in the ALSC summary report, Adirondack Lakes Study 1984-1987: An Evaluation of Fish Communities and Water Chemistry (Kretser et al. 1989). The summary report details the survey objectives, design, and techniques, and provides extensive summary statistics for all measured parameters. As a follow-up to this effort, the ALSC sponsored a series of interpretive analyses of the ALSC data set. The results from these analyses are presented in this report, which is organized in two parts: one dealing with the acid-base chemistry of Adirondack lakes, the other with fish communities and factors that influence them in Adirondack lakes. To guide these analyses, the ALSC Management Committee, which is comprised of members from the NYSDEC and ESEERCO (and its member utilities), identified a set of key questions of interest.

15311 (ORNL/M–1148, pp. 2.1-2.17) **Evaluation of the chemistry of ALSC lakes.** Driscoll, C.T.; Gallagher, J.; Munson, R.K. Oak Ridge National Lab., TN (USA); Adirondack Lakes Survey Corp., Ray Brook, NY (USA). 1990. In *Adirondack lakes survey: A interpretive analysis of fish communities and water chemistry, 1984–1987.* 431p. Order Number DE91005645. Source: OSTI; NTIS.

Interpretation of the ALSC chemical data was undertaken after all of the data had been collected; the results of these analyses are presented in this report- it is not our intent, however, to duplicate the summary statistics presented in Kretser et. al.(1989). Sections 2.1 and 2.2 present background information on the study and a description of the Adirondack region. Section 2.3 contains analyses of the interrelationships of water quality parameters and also provides a framework for understanding the subsequent interpretive analyses presented in Section 2.4 on lake classification and Section 2-5 on the integrated analyses. The remainder of this section describes the objectives and the approach used in the interpretive analyses. This is followed by descriptions of past synoptic lake acidification studies conducted in the Adirondacks and a brief overview of the Adirondack Lakes Survey. Finally, a discussion of the ALSC database and the quality of the data it contains is also presented.

15312 (ORNL/M–1148, pp. 2.18-2.26) **Adirondack region.** Newton, J.W. Oak Ridge National Lab., TN (USA); Adirondack Lakes Survey Corp., Ray Brook, NY (USA). 1990. In *Adirondack lakes survey: A interpretive analysis of fish communities and water chemistry, 1984–1987.* 431p. Order Number DE91005645. Source: OSTI; NTIS.

The author discusses the geology of the Adirondacks, including the physiography, bedrock geology and surficial geology. The climate and regional precipitation pattern are characterized. Land use in the Adirondacks is evaluated. The Adirondacks are subdivided into five large drainage basins. They are: Lake Champlain Basin, St. Lawrence-Raquette River Basin, Oswegatchie-Black River Basin, Mohawk-Hudson River Basin, and the Upper Hudson River Basin.

15313 (ORNL/M–1148, pp. 2.27-2.2.69) **Phenomenological analysis of ALSC chemistry data.** Munson, R.K.; Driscoll, C.T.; Gherini, S.A. Oak Ridge National Lab., TN (USA); Adirondack Lakes Survey Corp., Ray Brook, NY (USA). 1990. In *Adirondack lakes survey: A interpretive analysis of fish communities and water chemistry, 1984–1987.* 431p. Order Number DE91005645. Source: OSTI; NTIS.

The richness of the ALSC data base allows for the analysis of relationships among variables. These relationships indicate the importance of various processes occurring within the terrestrial and surface water systems that influence observed water quality. The analyses described below focus first on the mineral acid-base system and the components that make it up. This is followed by a section on atmospheric deposition and then by a discussion on the influence of organic and inorganic carbon (C). The concepts discussed in this section are used in the analysis of the ALSC data throughout this report. The analyses presented in this section, unless explicitly stated otherwise, use the ALSC water chemistry sample data (3984 samples), including replicates and samples taken during the biological surveys.

15314 (ORNL/M–1148, pp. 2.70-2.91) **Classification of ALSC lakes.** Newton, R.M.; Driscoll, C.T. Oak Ridge National Lab., TN (USA); Adirondack Lakes Survey Corp., Ray Brook, NY (USA). 1990. In *Adirondack lakes survey: A interpretive analysis of fish communities and water chemistry, 1984–1987.* 431p. Order Number DE91005645. Source: OSTI; NTIS.

The classification of Adirondack lakes provides a means for describing the chemical status of this diverse group of waters. It also provides a basis for regionally assessing the effects of changes in atmospheric deposition on surface water quality. Classification schemes may be based on chemical or watershed characteristics. Watershed-based classifications consider the physical characteristics within the basin to be most important in determining both the current chemical status and the susceptibility of the lakes to change. This section presents a water-quality-based classification for the ALSC lakes. The classification is preceded by a brief overview of the general physical and chemical characteristics of the ALSC lakes and of flowpath theory (Goldstein et al. 1984). This is followed by a discussion of the theory and application of lake classification. Finally, the ALSC and ELS data bases are compared in light of the classification scheme developed.

15315 (ORNL/M–1148, pp. 2.92-2.116) **Integrated analyses.** Munson, R.K.; Gherini, S.A.; Reckhow, K.H.; Driscoll, C.T. Oak Ridge National Lab., TN (USA); Adirondack Lakes Survey Corp., Ray Brook, NY (USA). 1990. In *Adirondack lakes survey: A interpretive analysis of fish communities and water chemistry,*

1984–1987. 431p. Order Number DE91005645. Source: OSTI; NTIS.

Information presented integrates the results of analyses presented earlier. A method was developed during the ALSC data alone whereby changes in H^+ concentration, and thus pH, can be predicted given changes in mineral acid-base concentrations and/or DOC. Using this method, pH changes of 0.17 and 0.38 pH units were predicted in response to a 30% reduction in sulfur deposition for 4 specific lakes from the lowest ANC classes described previously. The role of inorganic ligands in supporting H^+ in solution was also investigated. Most lakes had either more than 90% or less than 10% of their hydrogen ions supported by organic ligands. The distribution of organic support of H^+ varied among lake classes, with high-DOC lakes showing higher organic support. The strength of organic acids was also quantified. Dissolved organic carbon contributes 4.5 to 5 μeq/mg DOC of strong acid to solution. These strong organics decrease both pH and ANC, and thus the common practice of considering negative values of Gran ANC evidence of acidification solely by mineral acids is not supported by the ALSC data.

15316 (ORNL/M–1148, pp. 3.1-3.3.10) **Fish communities in Adirondack lakes.** Baker, J.; Gallagher, J. Oak Ridge National Lab., TN (USA); Adirondack Lakes Survey Corp., Ray Brook, NY (USA). 1990. In *Adirondack lakes survey: A interpretive analysis of fish communities and water chemistry, 1984–1987.* 431p. Order Number DE91005645. Source: OSTI; NTIS.

Numerous studies have been conducted on the effects of acid-base chemistry and acidification on fish communities in Adirondack lakes. The evidence for the importance of these processes includes the following: field bioassays – demonstrating that acidic surface waters with low pH and high levels of inorganic aluminum (Al) are toxic to fish and that toxic responses increase during acidic episodes; field experiments – such as those monitoring fish population responses to lake liming and subsequent reacidification, with associated declines in fish population survival and density; historical trend analyses – identifying the association between the loss of fish populations and current levels of pH and other acid-base chemistry variables; and field surveys – confirming the absence of fish (or fish species) from lakes with lower pH and higher levels of Al. However, many factors influence the suitability of lakes for fish population survival and reproduction and may also cause changes in fish communities over time. To ensure that the effects from acid-base chemistry are accurately assessed, it is essential to account for these other factors and activities. Thus, the underlying objectives of this analysis of the ALSC survey data are to (1) improve our understanding of the processes that affect fish distributions and trends in Adirondack lakes and (2) use this improved understanding to estimate the potential effects and future risks from changes in acid-base chemistry that may result from acidic deposition with greater confidence.

15317 (ORNL/M–1148, pp. 3.11-3.44) **Current status of fish communities in Adirondack lakes.** Gallagher, J.; Baker, J. Oak Ridge National Lab., TN (USA); Adirondack Lakes Survey Corp., Ray Brook, NY (USA). 1990. In *Adirondack lakes survey: A interpretive analysis of fish communities and water chemistry, 1984–1987.* 431p. Order Number DE91005645. Source: OSTI; NTIS.

A total of 202,207 individual fish representing 53 species (including three hybrids) were caught in lakes surveyed by the ALSC. The number of species caught per lake (i.e., species richness) ranged from 0 (fish absent) to 13, with a mean value of 3.7 and median of 3.0. Among the five watersheds, the median species richness varied from 1.0 for the Oswegatchie-Black and Mohawk-Hudson watersheds to 5.0 for the Lake Champlain watershed. Four fish species were caught in over half of the lakes surveyed by the ALSC with fish present: brown bullhead (Ictalurus nebulosus) (caught in 75% of the lakes with fish), brook trout (Salvelinus fontinalis) (52%), white sucker (Catostomus commersoni) (51%), and golden shiner (Notemigonus crysoleucas) (50%). In addition, five species accounted for approximately 70% of the total catch: brown bullhead, golden shiner, white sucker, yellow perch (Perca flavescens), and pumpkinseed (Lepomis gibbosus).

15318 (ORNL/M–1148, pp. 3.105-1.50) **Historical changes in fish communities in Adirondack lakes.** Baker, J.; Warren-Hicks, W.; Gallagher, J.; Christensen, S. Oak Ridge National Lab., TN (USA); Adirondack Lakes Survey Corp., Ray Brook, NY (USA). 1990. In *Adirondack lakes survey: A interpretive analysis of fish communities and water chemistry, 1984–1987.* 431p. Order Number DE91005645. Source: OSTI; NTIS.

Of the 1469 lakes surveyed by the ALSC, 868 (59%) were surveyed for fish in one or more years prior to the ALSC survey. An additional 109 lakes (7%) had historical reports of fish species occurrence. Our objectives was to use this historical information to assess changes in Adirondack fish communities through time and also probable causes for observed trends in the fish community. Of primary interest is the relative importance of fish population losses resulting from acidic deposition and lake acidification. The following questions were addressed: Are there more fishless lakes in the Adirondacks now than in the past? Do Adirondack lakes support fewer fish species now than in the past? How many lakes (and what proportion of the lakes with adequate data) appear to have lost fish population? What types of fish species have been lost? Are there obvious explanations, unrelated to acidic deposition, for observed fish population losses, such as a change in stocking, introductions of new species, or reclamation? How many fish populations have been lost with no apparent cause, other than perhaps surface water acidification? and Do lakes that have lost fish populations have (a) lower pH and ANC or (b) lower levels of DO or shallow-water at high-elevation conditions making them likely to experience winterkill, (c) introductions of non-native species, (d) active beaver populations, or (e) other characteristics that may affect fish communities?

15319 (ORNL/M–1148, pp. 3.45-3.71) **Habitat suitability for brook trout natural reproduction in Adirondack lakes.** Schofield, C. Oak Ridge National Lab., TN (USA); Adirondack Lakes Survey Corp., Ray Brook, NY (USA). 1990. In *Adirondack lakes survey: A interpretive analysis of fish communities and water chemistry, 1984–1987.* 431p. Order Number DE91005645. Source: OSTI; NTIS.

The brook trout (Salvelinus fontinalis) is the primary gamefish indigenous to the Adirondack region. Although brook trout are still widely distributed across the major drainage basins of the Adirondacks, they are notably absent from many acidic waters in the western drainages. Several management programs and experimental liming studies in the Adirondacks have demonstrated that brook trout populations can be established and maintained successfully by stocking in a variety of acidic lake types if water quality is controlled by limestone applications and other physical and chemical conditions are suitable for brook trout survival. However, relatively few self-maintaining brook trout populations have been established after acidic lakes were limed and stocked. Successful natural reproduction by stocked trout was observed in only 1 of 10 limed drainage lakes in the Extensive Liming Study, and intensive efforts to develop an NSA brook trout population in one acidified Adirondack lake (Woods Lake) have been unsuccessful to date. Prediction of NSA status (either historically or in the future) for the large number of currently acidic Adirondack lakes not supporting brook trout would be of value from both management and assessment perspectives. The ALSC data base was used in this study to examine the relationships between habitat characteristics and the reproductive status of Adirondack brook trout populations. The primary objective of this study was to evaluate criteria suitable for identifying Adirondack lakes with the potential to support brook trout natural reproduction. Based on the general knowledge of brook trout spawning requirements described above, it was hypothesized that Adirondack lakes receiving significant groundwater contributions to nearshore zones should have the greatest potential for NSA brook trout status.

15320 (ORNL/M–1148, pp. 3.72-3.80) **Patterns of fish species distribution in relation to lake/watershed characteristics.** Christensen, S.; Reckhow, K.; Beauchamp, J.; Shaakir-Ali, J.; Coe, J.; Baker, J.; Smith, E.; Gallagher, J. Oak Ridge National Lab., TN (USA); Adirondack Lakes Survey Corp., Ray Brook, NY (USA). 1990. In *Adirondack lakes survey: A interpretive analysis of*

fish communities and water chemistry, 1984–1987. 431p. Order Number DE91005645. Source: OSTI; NTIS.

The distribution of fish among Adirondack lakes is influenced by a large number of environmental and anthropogenic factors. The ALSC survey data, and the spatial association between fish presence/absence and lake characteristics, may be used to examine alternative hypotheses regarding the relative importance of these various factors in determining fish population success. Of particular interest is the degree to which lake acidity may restrict fish distributions from waters that might otherwise be suitable for fish survival. Multivariate regression analyses were used to identify lake and watershed characteristics and fishery management practices significantly associated with the occurrence of fish and the presence/absence of selected fish species in Adirondack lakes. Because of the complexity of these tasks and the number of different analyses, the methods and results are presented in detail in report appendices and only summarized briefly here. Three measures of fish status were examined: brook trout presence/absence, creek chub presence/absence, and the presence or absence of any fish species (fish/no fish). Fifty variables derived from the ALSC data base were identified that may potentially influence fish distributions. These were grouped into six broad categories: acidification response variables; baseline habitat suitability variables; productivity-related variables; natural reproduction and access variables; anthropogenic control variables; and biological variables.

15321 (ORNL/M–1148, pp. 3.81-3.104) **Fish species distribution patterns in selected Adirondack drainage systems.** Schofield, C. Oak Ridge National Lab., TN (USA); Adirondack Lakes Survey Corp., Ray Brook, NY (USA). 1990. In *Adirondack lakes survey: A interpretive analysis of fish communities and water chemistry, 1984–1987.* 431p. Order Number DE91005645. Source: OSTI; NTIS.

The integrated effects of differential physiological tolerances to acidification and behavioral regulation of environmental quality were examined in this study by determining fish species distribution patterns in relation to spatial water quality gradients within selected watersheds exhibiting different ranges in lake water quality. Using discrete drainage systems, where longitudinal gradients in water quality exist, allows these fish distribution regulatory processes to be expressed in terms of watershed-specific species distribution patterns. This approach could also provide a means of assessing the recolonization potential for sensitive fish species within watersheds that currently exhibit marked acidification gradients. A general pattern of decreasing lake acidity from small headwater lakes to larger downstream basins was documented in studies of the North Branch of the Moose River in the western Adirondacks. Correlated patterns in species richness and occurrences of acid-tolerant and sensitive fish species were associated with this longitudinal water quality gradient in the North Branch of the Moose River. The hypothesis that species distribution patterns across acidity gradients in this latter study by the observed species distributions and their measured tolerances to acidity. The primary objective of the current study was to further assess the application of this hypothesis to other Adirondack watersheds by using information on fish species occurrence and water quality available in the ALSC data base.

15322 (ORNL/TM–11360) **Transport of contaminants during storms in the White Oak Creek and Melton Branch watersheds.** Solomon, D.K.; Marsh, J.D.; Larsen, I.L.; Wickliff, D.S.; Clapp, R.B. Oak Ridge National Lab., TN (USA). Jan 1991. 130p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010445. Source: OSTI; NTIS; INIS; GPO Dep.

Environmental Sciences Division Publication No. 3395.

This report documents the transport of contaminants from Solid Waste Storage Area (SWSA) 5 along two principle pathways: the saturated groundwater system and the intermittently saturated storm flow system. The results of the storm flow sampling show a ^{90}Sr anomaly in SWSA 5 that is suggested by the similar mobility of ^{3}H and ^{90}Sr, in spite of the reactive nature of ^{90}Sr. An empirical relationship between concentration and discharge was established for ^{3}H and ^{90}Sr in the Melton Branch Watershed. The relationship is of the form $C = AD^{b}$, where C is concentration of either ^{3}H or ^{90}Sr, D is discharge at MBS, and A and b are empirical constants. A model was developed and a computer program written to separate the discharge into quick-flow and base flow components. The results of the modeling, using data collected during storm flow, showed that 44% of the annual stream discharge occurred as quick flow, whereas only 16% of the ^{3}H and 27% of the ^{90}Sr occurred as quick flow. The data show that for SWSA 5 the saturated groundwater pathway is quite important in dry years, such as the 1988 water year. Data from other areas, such as SWSA 6 suggest that the storm flow pathway may be more important in wet years. This study has several important implications for remedial actions and site monitoring. 23 refs., 52 figs., 2 tabs.

15323 (PINSTECH/RIAD–122) **Surface water/groundwater relationship in Chaj Doab.** Hussain, S.D.; Sajjad, M.I.; Akram, W.; Ahmad, M.; Rafiq, M.; Tariq, J.A. Pakistan Inst. of Nuclear Science and Technology, Islamabad (Pakistan). Radiation and Isotope Application Div. Jul 1990. 70p. Order Number DE91624470. Source: OSTI; NTIS (US Sales Only); INIS.

8 tab., 13 fig.

In order to understand the relationship between surface water and ground water in Chaj Doab (Pakistan), isotopic and chemical studies were undertaken. The data show that north eastern part of the doab, surface water and ground water are generally well connected and the recharge is mostly from the rivers either directly or through irrigation channels. Salinization of ground water is mainly due to dissolution of salts from soil sediments. (author). 8 tab., 13 fig.

15324 (PNL-SA–19276) **Biological treatment of Hanford groundwater: Development of an ex situ treatment process.** Brouns, T.M.; Koegler, S.S.; Fredrickson, J.K.; Luttrell, S.P.; Borgeson, K.A. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. (CONF-9103114–2: In situ and on-site bioreclamation: an international symposium, San Diego, CA (USA), 19-21 Mar 1991). Order Number DE91010008. Source: OSTI; NTIS; INIS; GPO Dep.

Liquid wastes containing radioactive, hazardous, and regulated chemicals have been generated throughout the 40 years of operations at the US Department of Energy's (DOE) Hanford Site in southeastern Washington state. Some of these wastes were discharged to the soil column, and many of the waste components, including nitrate ($NO_{3}-$) and carbon tetrachloride (CCl_{4}) have been detected in the groundwater of the unconfined aquifer at Hanford. The use of facultative anaerobic microorganisms is a promising technology for the ex situ and in situ removal of nitrates and organics from contaminated aqueous streams. This paper describes an ex situ biological process being developed at Pacific Northwest Laboratory for removal of $NO_{3}-$ and CCl_{4} from contaminated groundwater, and approaches for in situ denitrification and CCl_{4} biodegradation. 7 refs., 1 fig., 1 tab.

15325 (SAND–91-0476C) **Rapid moisture measurements in thin sand slabs.** Bell, J. (Cornell Univ., Ithaca, NY (USA)); Selker, J.S.; Steenhuis, T.S.; Glass, R.J. Sandia National Labs., Albuquerque, NM (USA). [1990]. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-901280–1: The American Society of Agricultural Engineers (ASAE) conference, Chicago, IL (USA), 18-21 Dec 1990). Order Number DE91009168. Source: OSTI; NTIS; GPO Dep.

The theoretical basis for the relationship between moisture content and light transmission (FFM) is developed, and shown to correspond well to the observed behavior. A calibration procedure for FFM based on the relationship between moisture content and matric potential is presented and tested. Means of expanding the range of sensitivity of the FFM are discussed. 9 refs., 11 figs., 1 tab.

15326 (SKB-TR–90-27) **Isolation and characterization of humics from natural waters.** Allard, B. (Linkoeping Univ. (Sweden). Dept. of Water and Environmental Studies); Arsenie, I.; Boren, H.; Ephraim, J.; Pettersson, C.; Gaardhammar, G. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). May 1990. 27p. Order Number DE91625728. Source: OSTI; NTIS (US Sales Only); INIS.

A method has been developed for quantitative recovery of humic substances from aqueous systems based on ion exchange on DEAE-cellulose. A scheme is suggested for the characterization of dissolved humic substances (UV-, IR- and ^{1}H NMR-spectroscopy, elemental analysis, molecular weight determination, ^{14}C-age, functionality, carbohydrate content and acid-base properties) as a routine in the chemical analysis of natural waters. (orig.).

15327 (SKB-TR--90-29) **Characterization of humic substances from deep groundwaters in granitic bedrock in Sweden.** Pettersson, C. (Linkoeping Univ. (Sweden). Dept. of Water and Environmental Studies); Ephraim, J.; Allard, B.; Boren, H. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Jun 1990. 26p. Order Number DE91625729. Source: OSTI; NTIS (US Sales Only); INIS.

Humic substances were isolated from deep groundwaters sampled at depths between 100 and 800 m at Finnsjoen, Fjaellveden, Forsmark, Gidea, Lansjaerv, Stripa and Aespoe. The humic fraction, which largely consisted of fulvic acid in all the samples, was characterized with respect to elemental composition, molecular weight, acid capacity (COOH and OH) as well as age (^{14}C). The differences in composition and capacity between old (1270-9675 y) and fresh (reference fulvic acid from surface water, Bersbo) were minor. (orig.).

15328 (SNV--3784) **A bibliography of Swedish acidification literature 1986-1989.** Saven, I. (ed.). National Swedish Environment Protection Board, Solna (Sweden). Jun 1990. 60p. Order Number DE91763505. Source: OSTI; NTIS (US Sales Only).

In Sweden the acidification research has been very intensive in the last few years - a fact reflected in the number of papers published. This issue covering four years contains some 550 entries as compared with about 750 for the previous 10-year period. Still we are more restrictive in including the titles under more than one headline in this issue. Furthermore, it has become increasingly difficult to identify which publications to include in an acidification bibliography. Nowadays, acidification issues form an integrated part of many environmental studies as well as of more basic research. In spite of these difficulties we have followed the same principles as in the first bibliography when selecting the material. Only easily retrievable material has been included. This excludes a number of local, mimeographed reports from university departments etc. Reports on air pollution and its effects in different ecosystems have been included only when there is an obvious connection to acidification. The reports must deal primarily with Swedish conditions. Some general reports have been included, though. The bibliography gives the titles in Swedish or English. When the title appears only in Swedish the paper contains no abstract or summary in English.

15329 (TRITA-KUT--1051) **Liming of acid ground water.** Sundloef, B. Royal Inst. of Tech., Stockholm (Sweden). Dept. of Land Improvement and Drainage. Apr 1989. 88p. (In Swedish). Order Number DE91763549. Source: OSTI; NTIS (US Sales Only).

Attempts have been made to spread calcium carbonate on the ground surface within the catchment area of the wells in various geological environments in order to assess the potential offered by such a method. It has been shown, however, that the effects on the ground water in most cases do not appear for some five years or more. It is also by no means certain whether significant improvements can be made with the method in question. Calcium carbonate (limestone) has several important advantages as an alkalizer. These include its low cost, safety in handling, and the fact that it is easily available and does not give rise to extremely high pH values in connection with overdosing. Two methods, based on the addition of calcium carbonate beneath the ground surface, have been developed and tested in field trials. One of the methods, which is primarily suitable for small sand and gravel aquifers, involves the infiltration of limestone slurry via pipes driven down below the water table. The other method, which is applicable for most kinds of unconsolidated formations, involves part of the water from the extraction well being reinfiltrated in a trench of limestone and sand some distance from the well. (20 figs., 12 tabs., 50 refs.).

15330 (WHC-SA--0989) **Radiological characterization of skyshine from a retired, low-level, radioactive liquid effluent disposal facility at Hanford.** Brown, R.C.; Perkins, C.J. Westinghouse Hanford Co., Richland, WA (USA). Feb 1991. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. (CONF-910270--35: Waste management '91, Tucson, AZ (USA), 24-28 Feb 1991). Order Number DE91009421. Source: OSTI; NTIS; GPO Dep.

The 1301-N Liquid Waste Disposal Facility, located on the Hanford Site received N Reactor low-level radioactive liquid process effluent from 1962 to 1985. Radiation emanating from the top of the trench sections was not significant because of the sediments were normally under several meters of water, which provided the necessary shielding. Following retirement of the facility, the liquid in the trench sections percolated into the ground leaving the residual radioactively contaminated sediments unshielded along the bottom and sides of the trench sections. The radioactive constituents of the contaminated sediments include the gamma-emitting isotopes Co-60 and Cs-137. Because of the lack of water covering, some of the gamma photons that were emitted upward were scattered downward due to Compton interaction with atmospheric constituents. This phenomenon is known as "skyshine." A radiological characterization was required to provide guidance for determining the effectiveness of interim stabilization alternatives that would not adversely affect future Resource Conservation and Recovery Act site closure activities, (e.g., filling in trench sections with spoils from excavation activities). A noninvasive radiological characterization of this disposal facility and the affected area of the Columbia River shoreline was conducted. This characterization confirmed that skyshine is the cause of the elevated shoreline exposure rates and provided a model that could be used to rate the effectiveness of alternative interim stabilization measures. 4 refs., 5 figs.

15331 (Y/Sub--91-YP507C/1-Pt.1) **Groundwater quality assessment for the Bear Creek hydrogeologic regime at the Y-12 Plant: Groundwater quality data and calculated rate of contaminant migration: Part 1.** Oak Ridge Y-12 Plant, TN (USA); HSW Environmental Consultants, Inc., Tampa, FL (USA). Feb 1991. 489p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OS21400. Order Number DE91009206. Source: OSTI; NTIS; GPO Dep.

Quarterly monitoring to assess the extent of anthropogenic compounds in the groundwater and their rate of migration has been in progress at the S-3 Site, Oil Landfarm, and Bear Creek Burial Grounds since 1986. The original assessment programs for these sites have been modified as needed to reflect each year's assessment results. In 1989, changes in the content and presentation of the assessment data in the GWQARs were implemented. A change in the presentation of the 1989 assessment data was initiated for two primary reasons. First, the expansion of the assessment program at each site had increased the level of effort to such a degree that it became increasingly difficult to complete a detailed evaluation of the data by the March 1 reporting deadline. Second, data obtained during previous years had indicated that plumes from several sources in Bear Creek Valley had intermingled. It became apparent that a more comprehensive perspective of the assessment of groundwater quality in the valley was needed. To address these issues, a single GWQAR was prepared in 1989 for the Bear Creek Hydrogeologic Regime (BCHR), which was defined as the area extending from the west end of the Y-2 Plant to the western side of the Bear Creek Burial Grounds. Part 1 contained all the assessment data obtained in 1989, along with a calculated rate of migration. The evaluation and interpretation of the assessment data was included in Part 2. This two part reporting convention has been continued for the 1990 assessment data. 42 refs., 17 figs., 3 tabs.

55 BIOMEDICAL SCIENCES, BASIC STUDIES

Refer also to citation(s) 14703

5501 Behavioral Biology

Refer also to citation(s) 15289

15332 (DOE/BP/07096–1) **System-wide significance of predation on juvenile salmonids in Columbia and Snake River reservoirs: Annual report of research 1990.** Petersen, C.J. (Fish and Wildlife Service, Seattle, WA (USA). Seattle National Fishery Research Center); Jepsen, D.B.; Nelle, R.D.; Shively, R.S.; Tabor, R.A.; Poe, T.P. USDOE Bonneville Power Administration, Portland, OR (USA). Div. of Fish and Wildlife; Fish and Wildlife Service, Seattle, WA (USA). Seattle National Fishery Research Center. Mar 1991. 57p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AI79-90BP07096. Order Number DE91009784. Source: OSTI; NTIS; GPO Dep.

The consumption rates of northern squawfish (Ptychocheilus oregonensis) preying upon juvenile salmonids were indexed in four reservoirs (Bonneville, The Dalles, John Day and McNary) of the lower Columbia River. During the spring and summer of 1990, over 2000 northern squawfish were collected from dam forebays, dam tailraces and mid-reservoir locations. Gut content data, predator weight and water temperature were used to compute a consumption index (CI) for northern squawfish. Juvenile salmonids were found in 435 of 1598 northern squawfish guts analyzed. Besides salmonids and other preyfish, crustaceans formed a significant portion of the diet. The CI of northern squawfish varied by season and location. At most locations, summer CI's of northern squawfish were higher than in the spring. Efforts to match sample collection with times of highest juvenile salmonid passage were successful except during July at The Dalles and Bonneville Reservoirs. Consumption indices were moderate to high at several locations even when passage was relatively low, suggesting salmonid predation rate by northern squawfish was not always a function of prey density. 19 refs., 5 figs., 12 tabs.

15333 (DOE/BP/39339–3) **Assessment of the fishery improvement opportunities on the Pend Oreille River: 1989 Annual report.** Barber, M.R. (Eastern Washington Univ., Cheney, WA (USA). Upper Columbia United Tribes Fisheries Center); Renberg, B.L.; Vella, J.J.; Scholz, K.L.; Woodward, K.L.; Graves, S. USDOE Bonneville Power Administration, Portland, OR (USA). Div. of Fish and Wildlife; Eastern Washington Univ., Cheney, WA (USA). Upper Columbia United Tribes Fisheries Center. Sep 1990. 413p. Sponsored by USDOE, Washington, DC (USA); Department of the Interior, Washington, DC (USA). DOE Contract BI79-88BP39339. Order Number DE91009702. Source: OSTI; NTIS; GPO Dep.

The purpose of this study was to assess the fishery improvement opportunities on the Box Canyon portion of the Pend Oreille River. This three year study was initiated as part of the Northwest Power Planning Council's 1987 Columbia River Basin Fish and Wildlife Program. This report contains the findings of the second year of the study. Currently, yellow perch (Perca flavescens [Mitchill]) are the predominant fish species in the river and largemouth bass (Micropterus salmoides [Lacepede]) are the predominant sport fish. The objectives of the second year of the study were to determine: the relative abundance of each species in the river and sloughs; the population levels in five selected tributaries and, if possible, for fish in the river and sloughs; fish growth rates; the feeding habits and abundance of preferred prey; migration patterns; and the total fishing pressure, catch-per-unit-effort, and total harvest by conducting a year-round creel survey. 55 refs., 7 figs., 154 tabs.

5502 Biochemistry

Refer also to citation(s) 14411, 15306, 15346, 15382, 15435

15334 (BNL–45931) **Restriction/modification systems of pneumococci: Why two methylases in the DpnII system?.** Lacks, S.A.; Springhorn, S.S.; Cerritelli, S. Brookhaven National Lab., Upton, NY (USA). [1990]. 21p. Sponsored by USDOE, Washington, DC (USA); Department of Health and Human Services, Washington, DC (USA). DOE Contract AC02-76CH00016. Grant GM29721. (CONF-9006331–1: 3. international conference on streptococcal genetics, Minneapolis, MN (USA), 6-9 Jun 1990; BIO–4625). Order Number DE91010372. Source: OSTI; NTIS; GPO Dep.

The systems for DNA restriction and modification in Streptococcus pneumoniae are unusual in three respects. First, the DpnI restriction endonuclease only acts on a methylated site in DNA. Since DpnI attacks only methylated DNA, cells that make it do not require modification of their DNA. Second, strains of S. pneumoniae that do not harbor DpnI contain a complementary restriction system, that of DpnII. The DpnI and DpnII systems are mutually exclusive because DNA from a DpnI strain, which is not methylated at 5′-GATC-3′ sites, is susceptible to DpnII, and DNA from a DpnII strain, which contains 5′-GmeATC-3′, is susceptible to DpnI. Third, genetic and biochemical analysis of the DpnI and DpnII systems revealed an additional, unexpected protein in each of the restriction systems. In the DpnII system three proteins are produced, whereas in a typical restriction system, which like DpnII cleaves at unmethylated sites, only two proteins are generally found - the restriction endonuclease and a modification methylase. The function and significance of the additional protein in the DpnII system will be a major focus of this chapter. 21 refs., 2 figs., 1 tab.

15335 (DOE/BP/35245–3) **Assessment of smolt condition for travel time analysis: Annual report, 1989.** Beeman, J.W.; Rondorf, D.W.; Faler, J.C.; Free, M.E.; Haner, P.V. Fish and Wildlife Service, Seattle, WA (USA). Seattle National Fishery Research Center. Nov 1990. 120p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AI79-87BP35245. Order Number DE91009693. Source: OSTI; NTIS; GPO Dep.

The Water Budget is a volume of water used to enhance environmental conditions (flows) in the Columbia and Snake rivers for juvenile salmonids during their seaward migration. To manage the Water Budget, the Fish Passage Center estimates travel times of juvenile salmonids in index reaches of the main-stem rivers, using information on river flows and the migrational characteristics of the juvenile salmonids. This study was initiated to provide physiological information on the juvenile salmonids used for these travel time estimates. The physiological ability to respond to stressors was evaluated by measuring concentrations of plasma cortisol, glucose, and chlorides before and after a 30-s handling-stress challenge test. The development of smoltification was assessed by measuring gill Na^+–K^+ ATPase activity and plasma thyroxine concentrations. Prevalence of bacterial kidney disease in spring chinook salmon was generally higher than in 1988, ranging from 81–100% using an enzyme-linked immunosorbent assay (ELISA) method. Fish from Snake River hatcheries had more severe infections than those from mid-Columbia hatcheries. 42 refs., 19 figs., 4 tabs.

15336 (DOE/ER/12031–T3) **[Starch synthesis in the maize endosperm as affected by starch synthesizing mutants].** Wisconsin Univ., Madison, WI (USA). Lab. of Genetics. 2 Oct 1985. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-82ER12031. Order Number DE91010194. Source: OSTI; NTIS; GPO Dep.

A recent findings is that the activity of the solubilized starch granule-bound enzyme is enhanced by the addition of Glc-1,6-bisP to a reaction mixture containing Glc-1-P as a substrate. The addition of F-1,6-bisP is nearly as effective as that of Glc-1,6-bisP while F-1-P, F-6-P, R-1-P, R-5-P, Ru-1,5-bisP, or Maltose-1-P are ineffective. It is a tenable hypothesis at the present time that Glc-1,6-bisP is also utilized as a substrate by the oligosaccharide synthase or another enzyme associated with it in the high molecular complex which contains the oligosaccharide synthase that has been freed from the starch granules by the procedure of MacDonald and Preiss. This fraction also appears to be capable of interconverting Glc-1,6-bisP and F-1,6-bisP and this can account for the observation that F-1,6-bisP has the ability to accelerate the incorporation of Glc-1-P into oligosaccharides as does Glc-1,6-bisP. They are attempting currently to test the possibility that Glc-1,6-P is utilized to some extent as a substrate and that the PO_4 present on C6 in some Glc moieties in the oligosaccharide chains derives from this source.

15337 (DOE/ER/13495–T4) **[Anaerobic metabolism of aromatic compounds by phototrophic bacteria: Biochemical aspects]: Progress report, April 1, 1990–December 10, 1990.** Gibson, J. Cornell Univ., Ithaca, NY (USA). Dept. of Microbiology. [1990]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-86ER13495. Order Number DE91009799. Source: OSTI; NTIS; GPO Dep.

Major effort has gone into purifying and characterizing a second Coenzyme A ligase involved in anaerobic aromatic acid

metabolism in Rhodopseudomonas palustris. This enzyme has some overlap in specificity with the benzoate-CoA ligase previously characterized, but differs in many other characteristics, and is antigenically unrelated. Some amino acid sequence information has been obtained, and this as well as a highly specific antiserum, will be useful for cloning the structural gene for the new ligase. In collaboration with Dr. Harwood, at the University of Iowa, we have continued to characterize a group of mutants obtained after Tn5 insertion into our clone bank, followed by transfer of the entire mutagenized bank into wild-type R. palustris. A clone which complements a group of these mutations has been insolated, and is currently being tested for ability to restore anaerobic growth on aromatic acids to other mutants isolated after chemical or uv mutagenesis of the wild-type strain. The close ties with Dr. Harwood's lab were demonstrated by the week-long visit of one of her students during last summer, to learn how to purify the benzoate CoA ligase from R. palustris. A search for possible intermediates in anaerobic metabolism of benzoyl CoA has been initiated in collaboration with Dr. Gibson, focussing on the possible role 1,4-dihydrobenzoyl CoA as a first reduction product.

15338 (DOE/ER/13496–5) **Characterization of rhamnogalacturonan I from cotton suspension culture cell walls: [Progress report].** Oklahoma State Univ., Stillwater, OK (USA). [1991]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-86ER13496. Order Number DE91009519. Source: OSTI; NTIS; GPO Dep.

Progress has been made on the project of determining the structure of pectins. From recent progress, a covalent crosslink between rhamnogalacturonan I (RGI) and xyloglucan was hypothesized and a structure for RGI was proposed. The development of a method to determine the distribution of methyl esterification with pectins also progressed. The degree of methyl esterification of cotton cotyledon cell walls was compared to that of cotton suspension cultures. Cotyledon wall were found to have ~55% of the galacturonic acid esterified whereas suspension culture wall were only about 14% methyl esterified. 10 refs. (SM)

15339 (DOE/ER/13970–2) **CARBBANK–A structural and bibliographic data base: Annual technical progress report.** Albersheim, P. Georgia Univ., Athens, GA (USA). Complex Carbohydrate Research Center. May 1990. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG09-88ER13970. Order Number DE91010621. Source: OSTI; NTIS; GPO Dep.

An IBM PC-compatible computerized Complex Carbohydrate Structure Database (CCSD) and database management system (CarbBank) were created by researchers at the Complex Carbohydrate Research Center (CCRC) to meet the needs of persons interested in carbohydrate science. CarbBank fully supports all carbohydrates found in glycoproteins and glycolipids. They are enhancing CarbBank to provide full support for plant and bacterial oligo- and polysaccharides. The authors are creating a portable database format for the CCSD and a database core engine for CarbBank. A CCSD database format is independent of both the application programming language and the computer operating software will make the CCSD compatible with the newest relational database systems being developed for nucleotide sequences, amino acid sequences as for mass and NMR spectra by the National Center for Biotechnology Information. The CarbBank core engine, which is being written in the C++ language, can be linked into the new database system. The core engine plus system-specific interface tool kits will also allow CarbBank to be ported to more powerful computer operating systems for the PC, such as Microsoft Windows/386 and IBM PC OS/2, to RISC-based and UNIX work stations, and to Macintosh computers. The planned enhancements will enable CarbBank and information in the CCSD to be closely integrated with the larger sequence databases. These enhancements will also allow them to support the expanding needs of researchers interested in obtaining and analyzing carbohydrate sequence information.

15340 (DOE/ER/60406–T3) **[Structure and stability of nucleic acids]: Progress report, July 1, 1985–June 30, 1988.** Tinoco, I. Jr. California Univ., Berkeley, CA (USA). Dept. of Chemistry. [1988]. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG03-86ER60406. Order Number DE91008274. Source: OSTI; NTIS; GPO Dep.

We have studied the conformations of DNA and RNA oligonucleotides in order to relate their structures to their biological roles. We have discovered a novel conformation for a guanine-rich sequence which occurs in telomeres. This finding of one biologically relevant non-Watson-Crick base pair suggests that other non-standard pairs may be important. We have continued a systematic study of the thermodynamics of base pair formation in double stranded DNA. We have established the conformation and thermodynamics of a 3 in. viral RNA structural element. We have made a direct comparison between the thermodynamic stability of mismatched bases and the kinetics of misincorporation of bases by DNA polymerase. Drosophila spermatogenesis and sickle hemoglobin polymerization have been studied with the differential polarization microscope, which was invented and developed in this laboratory. Left-handed Z-RNA, discovered in this laboratory in 1984, has been characterized by NMR, circular dichroism and Raman scattering. (MHB)

15341 (DOE/ER/60673–1) **[Neutron scatter studies of chromatin structure related to function]: [Progress report], April 1988–April 1990.** Bradbury, E.M. California Univ., Davis, CA (USA). Dept. of Biological Chemistry. [1990]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG03-88ER60673. Order Number DE91010307. Source: OSTI; NTIS; INIS; GPO Dep.

This study is concerned with the application of neutron scatter techniques to the different structural states of nucleosomes and chromatin with the long term objective of understanding how the enormous lengths of DNA are folded into chromosomes. Micrococcal nuclease digestion kinetics have defined two subnucleosome particles; the chromatosome with 168 bp DNA, the histone octamer and one H1 and the nucleosome core particle with 146 bp DNA and the histone octamer. As will be discussed, the structure of the 146 bp DNA core particle is known in solution at low resolution from neutron scatter studies and in crystals. Based on this structure, the authors have a working model for the chromatosome and the mode of binding of H1. In order to define the structure of the nucleosome and also the different orders of chromatin structures they need to know the paths of DNA that link nucleosomes and the factors associated with chromosome functions that act on those DNA paths. The major region for this situation is the inherent variabilities in nucleosome DNA sequences, in the histone subtypes and their states of chemical modification and in the precise locations of nucleosomes. Such variabilities obscure the underlying principles that govern the packaging of DNA into the different structural states of nucleosomes and chromatin. The only way to elucidate these principles is to study the structures of nucleosomes and oligonucleosomes that are fully defined. They have largely achieved these objectives.

15342 (DOE/ER/60673–T1) **Neutron scatter studies of chromatin structures related to function: Progress report, July 1, 1989–April 30, 1990.** California Univ., Davis, CA (USA). Dept. of Physics. [1990]. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG03-88ER60673. Order Number DE91009837. Source: OSTI; NTIS; INIS; GPO Dep.

In the Progress Report for last year (7-1-88 to 6-30-89) we proposed to complete the following experiments: (1) Structure of TFIIIA/DNA complex, (2) Effect of histone acetylation on nucleosome structure, and (3) Location of lysine rich histone H5 on the nucleosome. Our major source of neutrons is LANSCE, LANL. However, for the period of this report LANSCE has been down between cycles of operation. Continuing neutron scatter studies have been carried out at the Institute Laue Langevin, Grenoble, France, on the trimmed nucleosome core particles. X-ray scatter studies have been carried out at DESY, Hamburg on the histone octamer and trimmed octamer. X-ray scatter studies have been performed also at LANL on proposed objectives. We have continued with the following of our research program; (i) assembly of fully characterized nucleosomes; (ii) effect of histone acetylation on nucleosomes; (iii) effect of full acetylation of H3 and H4 on nucleosome DNA linking number; (iv) assembly and characterization of defined minichromosomes; (v) neutron and X-ray scatter of the

histone octamer and trimmed octamer; (vi) structural studies of human sperm chromatin, histones and protamines. 5 refs.

15343 (EUR–12717) **Studies on the enzymology of cellulose degradation by the anaerobic bacterium Clostridium thermocellum and the anaerobic fungus Neocallimastix frontalis: Final report, November 1, 1986–Octoboer 31, 1989.** Bhat, K.M. (Rowett Research Inst., Aberdeen (UK)); Gow, L.A.; Wilson, C.A.; Wood, T.W. Commission of the European Communities, Luxembourg (Luxembourg). Directorate General Telecommunications, Information Industries and Innovation; Rowett Research Inst., Aberdeen (UK). 1990. 119p. Sponsored by Commission of the European Communities, Brussels (Belgium). Contract EN3B-0084-UK(HI). Source: OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg.

The extracellular cellulases from the anaerobic bacterium Clostridium thermocellum and the anaerobic rumen fungus Neocallimastix frontalis are very active on crystalline cellulose. In both cases the activity resides in a high molecular weight complex. The complex from C. thermocellum (termed the cellulosome) was found to be readily dissociated at pH 5.0 and at room temperature by a mixture of SDS, EDTA and DTT. Virtually all the activity of the unfractionated cellulosome was recovered when the dissociated enzyme components were reassociated by dialysis. Thus, the route is now established for the first time for a meaningful study of the mechanism of cellulase action of this commercially important enzyme system. Nearly all of the activity to crystalline cellulose shown by the cellulase of N. frontalis was associated with a fraction which comprised only 2% of the extracellular protein, 3% of the endoglucanase and 3% of the β-glucosidase. This fraction, which could be isolated by affinity chromatography on cellulose, was produced in greater quantity when the fungus was grown in co-culture with the methanogen, Methanobrevibacter smithii. The specific activity of the partially purified enzyme for degradation of crystalline cellulose was several-fold greater than that produced by the aerobic fungus T. reesei, which is being developed world-wide for its commercial potential for converting cellulose to fermentable soluble sugars. The cellulase of N. frontalis clearly has great commercial potential. 39 refs., 19 figs., 22 tabs.

5503 Cytology

Refer also to citation(s) 15338, 15352

15344 (LA-UR–91-732) **Problems in understanding the organization, structure and function of chromosomes.** Bradbury, E.M. (Lawrence Livermore National Lab., CA (USA)). Lawrence Livermore National Lab., CA (USA). [1990]. 17p. Sponsored by USDOE, Washington, DC (USA); Department of Health and Human Services, Washington, DC (USA). DOE Contract W-7405-ENG-36 ;FG03-88ER60673. GRANT PHS GM-26901;GRANT CD-484F. (CONF-9005329–1: NATO symposium, Scilly (Italy), May 1990). Order Number DE91009939. Source: OSTI; NTIS; GPO Dep.

Despite intensive investigation of mammalian chromosomes, we are still largely ignorant of the basic rules that govern their organization, structure, and functions. This situation results from the current limitations in available technologies to elucidate the structures of such complex biological systems. Whereas the powerful techniques of molecular biology have successfully addressed at high resolution functional problems at the level of nucleic acid sequences, many lower resolution questions concerning the architecture of the cell nucleus, long range order in chromosomes, and higher order chromatin structures remain largely unanswered. Techniques are now emerging that should help to remedy this situation. The use of confocal microscopy with molecular probes will tell us at the level of the light microscope a great deal about the organization of the nucleus and how it changes in different cell types; advanced light sources have the potential to image hydrated biological systems down to 10 nm, and scanning electron tunneling and atomic force microscopies have demonstrated their ability to image molecules though their ability to usefully image biomolecules such as DNA remains to be demonstrated. 32 refs., 6 figs.

5504 Genetics

Refer also to citation(s) 13954, 13956, 13968, 13969

15345 (DOE/ER/60997–T1) **[New hosts and vectors for genome cloning]: Progress report.** California Inst. of Biological Research, La Jolla, CA (USA). 28 Feb 1991. 3p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG03-90ER60997. Order Number DE91009996. Source: OSTI; NTIS; GPO Dep.

The main goal of our project has been to develop new bacterial hosts and vectors for cloning human DNA in the bacterium E. coli. Because human DNA is both A+T-rich and highly repetitive, many human sequences are unstable as inserts in vectors that are propagated in bacteria. During the past eight months, we have (1) assessed what fraction of human DNA inserts in cosmid vectors is unstable, (2) developed new host strains that help stabilize unstable sequence features of human DNA, and (3) begun the development of a new generation of cloning vectors that should permit the more stable maintenance and more facile analysis of large human DNA inserts.

15346 (LA-UR–90-2884) **Robotics for recombinant DNA and human genetics research.** Beugelsdijk, T.J. Los Alamos National Lab., NM (USA). [1990]. 29p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910637–1: 5. international conference on advanced robotics, Pisa (Italy), 20-22 Jun 1991). Order Number DE90016440. Source: OSTI; NTIS; GPO Dep.

In October of 1989, molecular biologists throughout the world formally embarked on ultimately determining the set of genetic instructions for a human being. Called by some the "Manhattan Project" a molecular biology, pursuit of this goal is projected to require approximately 3000 man years of effort over a 15-year period. The Humane Genome Initiative is a worldwide research effort that has the goal of analyzing the structure of human deoxyribonucleic acid (DNA) and determining the location of all human genes. The Department of Energy (DOE) has designated three of its national laboratories as centers for the Human Genome Project. These are Los Alamos National Laboratory (LANL), Lawrence Livermore National Laboratory (LLNL), and Lawrence Berkeley Laboratory (LBL). These laboratories are currently working on different, but complementary technology development areas in support of the Human Genome Project. The robotics group at LANL is currently working at developing the technologies that address the problems associated with physical mapping. This article describes some of these problems and discusses some of the robotics approaches and engineering tolls applicable to their solution. 7 refs., 8 figs., 1 tab.

5505 Metabolism

Refer also to citation(s) 15343

5506 Medicine

Refer also to citation(s) 14976, 15354, 15788, 15790

15347 (BNL–45809) **An optimized epithermal neutron beam for neutron capture therapy (NCT) at the Brookhaven Medical Research Reactor (BMRR).** Fairchild, R.G. (Brookhaven National Lab., Upton, NY (USA)); Saraf, S.K.; Fiarman, S.; Kamen, Y.; Benary, V.; Kalef-Ezra, J.; Brugger, R.M.; Shih, A.; Gahbauer, R.A.; Goodman, J.H. Brookhaven National Lab., Upton, NY (USA). [1990]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-901226–1: 4. international symposium on neutron capture therapy, Sydney (Australia), 3-7 Dec 1990). Order Number DE91009470. Source: OSTI; NTIS; GPO Dep.

The Brookhaven Medical Research Reactor (BMRR) was built primarily for clinical applications of NCT, with an improved beam extraction facility providing flexibility for future development of filters/moderators for NCT. This flexibility was exploited to provide an optimized epithermal neutron beam which was recently installed and tested in the east irradiation facility (shutter) of the BMRR. The new epithermal neutron beam was implemented using an Al_2O_3 moderator or "Spectrum Shifter" which was designed, installed and

tested in collaboration with associates at Idaho National Engineering Laboratory (INEL). The resultant beam is "optimized" in that the fast neutron and γ contaminations have been reduced to acceptable values (less than a few % of maximum normal tissue dose), while the epithermal neutron flux density of 1.8×10^9 n/cm^2-sec allows NCT to be carried out in 30 min in a single application. It is, however, anticipated that clinical application of NCT will be carried out in ~4 fractions (~15 min each, with bilateral irradiations), as recommended by an international committee convened to recommend the best approach to clinical trials. Biological parameters have been determined for the above beam, as described below. It is expected that sufficient data will be accumulated in ongoing phase 1 clinical trials with BSH and BPA, to allow a decision to be made about the advisability of initiating therapy trials in humans, in ~12–24 months.

15348 (DOE/ER/60899–5) **Rapid diagnosis of occult abscesses using ^{99m}Tc-labeled monoclonal antibodies.** Coons, T.A. (RhoMed, Inc., Albuquerque, NM (USA)); Rhodes, B.A.; Thakur, M.L.; Marcus, C.S.; Ballou, B. RhoMed, Inc., Albuquerque, NM (USA). [1991]. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG04-89ER60899. (CONF-9103141–1: Keystone symposium on monoclonal antibodies, Denver, CO (USA), 10-16 Mar 1991). Order Number DE91009258. Source: OSTI; NTIS; GPO Dep.

Acute infections, such as appendicitis and occult infections in AIDS patients, can be diagnosed within two hours by gamma scintigraphy after i.v. administration of ^{99m}Tc labeled antibodies reactive with human granulocytes. The antibody, murine IgM anti-SSEA-1, is partially reduced using Sn(II) to expose and protect reactive sulfide groups. The antibody is then purified, stannous tartrate and stabilizers are added, and the mixture is lyophilized. To label, sodium pertechnetate is added. After a 15 minute incubation the tracer drug is injected. The rate of accumulation and degree of concentration at the site of infection is presumptively determinative of the severity of the infection. Acceptance criteria and tests for the ^{99m}Tc labeled antibody product have been established and validated. Greater than 93% of the ^{99m}Tc is firmly bound to the protein as determined by quantitative HPLC. Radiochemical impurities, colloidal ^{99m}Tc and free pertechnetate are together less than 4% as determined by thin layer chromatography. The immunoreactive fraction, measured by binding to solid phase antigen, and affinity measured be ELISA, are unchanged by the ^{99m}Tc-direct labeling process. Two hour blood clearance in rats is within 90% of the value of the ^{125}I labeled analog. The immunoreactive fraction decreases less than 10% when incubated in human plasma for 24 hours. This method has been compared to other direct labeling methods, and found to give higher radiochemical yields. 5 figs.

15349 (EGG-BNCT–8777-VOL.4-NO.12) **Power burst facility/boron neutron capture therapy program for cancer treatment: Monthly bulletin, Volume 4, No. 12: December 1990.** Ackermann, A.L. (eds.); Dorn, R.V. III. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1990. 33p. Sponsored by USDOE, Washington, DC . (USA). DOE Contract AC07-76ID01570. Order Number DE91010069. Source: OSTI; NTIS; GPO Dep.

This report presents a summary of accomplishments and highlights in the PBF/BNCT Program for December 1990. The report includes information on the BNCT brain tumor and melanoma research programs, technical support and modifications, PBF operations, a milestone summary, and animal data charts. Projects include: Supporting Technology; Large Animal Studies; Human Studies; and Neutron Source and Facility Preparation. 1 fig.

15350 (EGG-BNCT–9411-Vol.5-No.1) **PBF/BNCT Program: Monthly bulletin, January 1991: Volumes 5, No. 1.** Ackermann, A.L. (ed.); Dorn, R.V. III. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1991. 42p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. Order Number DE91010051. Source: OSTI; NTIS; GPO Dep.

This report presents a summary of accomplishments and highlights in the PBF/BNCT Program for January 1991. The report includes information on the BNCT brain tumor and melanoma research programs, technical support and modifications, PBF operations, a milestone summary, and animal data charts. Projects include Supporting Technology Development; Large Animal Studies; Human Studies; and Neutron Source and Facility Preparation.

15351 (INIS-mf–12806, pp. 317-323) **Medical applications of radioisotopes.** Lentle, B.C. (Alberta Univ., Edmonton, AB (Canada)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

The applications of radionuclides in medicine can be classified as: (a) in vitro tests; (b) in vivo tests - imaging and non-imaging; (c) uses in treatment. In vitro uses are important but use very small activities and are in part being replaced by such alternative methods as enzymatic assays. The major uses of radionuclides in medicine are in in vivo diagnosis; these uses are those in which small amounts of radiotracer, usually between 75 and 750 megabecquerels, are administered to patients and the activity either measured or imaged. Lastly there are a few therapeutic uses of injected radionuclides, although such uses may involve activities of up to 6000 megabecquerels each.

5507 Microbiology

Refer also to citation(s) 13954, 13956, 13963, 13968, 13969, 14000, 14161, 14382, 15343

5509 Pathology

Refer also to citation(s) 15335, 15352

5510 Physiological Systems

15352 (DOE/ER/60409–5) **Modulation of lymphopoiesis: Annual report.** Rosse, C. Washington Univ., Seattle, WA (USA). Dept. of Biological Structure. [1990]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-86ER60409. Order Number DE91009592. Source: OSTI; NTIS; GPO Dep.

Ongoing experiments contribute to the four specific aims in our current 3-year project period studying lymphopoiesis using CE mammary adenocarcinoma (CE maca) mice. Specific Aim 1: Function of Bone Marrow Stroma in CE Maca Bearing Mice. We have concluded that bone marrow stromal cells from tumor bearing animals are as effective as bone marrow stromal cells from normal animals at supporting B lymphopoiesis in culture. If stromal cell disfunction occurs in tumor bearing animals, the effect is not long lasting. Specific Aim 2: Factors Elaborated by CE Maca. Conditioned medium from CE maca cultures induces bone resorbing activity in bone organ cultures. We have identified a 32 kDa protein that meets the criteria for an osteoclast specific growth factor in this medium. However, we have also found that even though an osteoclast specific growth factor exists, a growth factor whose primary targets are granulocyte precursors will also stimulate osteoclast activity. Specific Aim 3: In Vitro Systems for Investigating Modulation of NK Lymphopoiesis by CE Maca. CE maca is shown to inhibit NK all production as well as B all production. In the course of the these experiments, we have established conditions for enriching NK precursors and have established a prototype long term bone marrow culture system which shows NK cell production. Specific Aim 4: Relationship Between Myciogenic and Intrathymic T Cell Precursors. There is evidence for a stream of T all maturation in both host (or intrathymic) cells and non-host (both hematogenous and intrathymic) cells. If thymic atrophy is induced by cortisone (a depopulation equivalent to that caused by 1000 rad) our data conclusively show thymic recovery is effected almost exclusively by intrathymic cells. This assigns a much greater importance to intrathymic T all progenitors in the maintenance of T cell production in the thymus than has been hitherto recognized. (MHB)

15353 (LA-UR–91-829) **Linking structure and function: Information processing in the brain.** Gremillion, M.A.V. Los Alamos National Lab., NM (USA). [1990]. 24p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9006299–: 1990 Santa Fe Institute summer school on

complex systems, Santa Fe, NM (USA), 12-16 Jun 1990). Order Number DE91009946. Source: OSTI; NTIS; GPO Dep.

Traditionally, theories of function in neuroscience have emerged from physiology. Physiologists have suggested a number of means by which information in the brain can be processed, yet the principles underlying the generation of these phenomena are not well understood. A complex systems approach would be to examine the overall structure and function of the system and to attempt to establish a common framework for information processing interactions. This paper will use the structure-function relationship as a basis for exploring units of information processing. It will examine the brain as a whole, first providing the non-specialists with an short overview of the structure and some of the functions or outputs of the brain. It then very briefly reviews three of the prominent theoretical concepts that have emerged in the last few decades: receptive fields, feature extraction, and parallel processing. Next, it addresses the question of information processing and outlines the structures which have traditionally been proposed to be the basic unit of information processing. An alternative unit on which information processing in the brain might be based is then proposed, and data outlined to support it. Finally, the implications of this different mode of processing are discussed, both for the brain and for other complex systems. 40 refs., 4 figs., 2 tabs.

15354 (LBL-PUB–682/12-90) **Form and function: Perspectives on structural biology and resources for the future.** Vaughan, D. (ed.). Lawrence Berkeley Lab., CA (USA). Dec 1990. 50p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91009879. Source: OSTI; NTIS; INIS; GPO Dep.

The purpose of this study is largely to explore and expand on the thesis that biological structures and their functions are suited to. Form indeed follows function and if we are to understand the workings of a living system, with all that such an understanding promises, we must first seek to describe the structure of its parts. Descriptions of a few achievements of structural biology lay the groundwork, but the substance of this booklet is a discussion of important questions yet unanswered and opportunities just beyond our grasp. The concluding pages then outline a course of action in which the Department of Energy would exercise its responsibility to develop the major resources needed to extend our reach and to answer some of those unanswered questions. 22 figs.

5530 Agriculture and Food Technology

Refer also to citation(s) 14360, 14991

15355 (DOE/ID/12608–3-Vol.1) **Design and control of energy efficient food drying processes with specific reference to quality; Model development and experimental studies: Moisture movement and dryer design: Phase 2, Final report, July 1, 1987–August 31, 1989.** Kim, M.; Litchfield, B.; Singh, R.; Liang, H.; Narsimhan, G.; Waananen, K. Purdue Univ., Lafayette, IN (USA). Aug 1989. 192p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG07-85ID12608. Order Number DE91010644. Source: OSTI; NTIS; GPO Dep.

The ultimate goal of the project is to develop procedures, techniques, data and other information that will aid in the design of cost effective and energy efficient drying processes that produce high quality foods. This objective has been sought by performing studies to determine the pertinent properties of food products, by developing models to describe the fundamental phenomena of food drying and by testing the models at laboratory scale. Finally, this information is used to develop recommendations and strategies for improved dryer design and control. This volume, Model Development and Experimental Studies, emphasizes the direct and indirect drying processes. An extensive literature review identifies key characteristics of drying models including controlling process resistances, internal mechanisms of moisture movement, structural and thermodynamic assumptions, and methods of model coefficients and material property measurement/determination, model solution, and model validation. Similarities and differences between previous work are noted, and strategies for future drying model development are suggested.

15356 (DOE/ID/12608–T1) **Design and control of energy efficient drying processes with specific reference to foods: Technical progress report, September 25, 1985–December 31, 1985.** Franzen, K.; Liang, H.; Litchfield, B.; Murikami, E.; Nichols, C.; Wannanan, K.; Miles, G.; Okos, M. Purdue Univ., Lafayette, IN (USA). Dec 1985. 29p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG07-85ID12608. Order Number DE91010706. Source: OSTI; NTIS; GPO Dep.

The objective of this project is to perform fundamental studies in the area of food drying. This objective will be accomplished by performing studies to determine the pertinent properties of food products, by developing models to describe the fundamental phenomena of food drying and by testing the models at the laboratory scale. These data will be used to develop strategies for reducing the energy requirements of food drying. The report summarizes the progress made on Task 1, Literature Review and Task 2, Analytical Techniques Development.

15357 (DOE/ID/12608–T2) **Design and control of energy efficient drying processes with specific reference to foods: Technical progress report, April 1, 1986–June 30, 1986.** Franzen, K.; Liang, H.; Litchfield, B.; Murakami, E.; Nichols, C.; Wannanan, K.; Miles, G.; Okos, M. Purdue Univ., Lafayette, IN (USA). Aug 1986. 118p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG07-85ID12608. Order Number DE91010707. Source: OSTI; NTIS; GPO Dep.

The overall objective of this project is to perform fundamental studies in the area of food drying. This objective will be accomplished by performing studies to determine the pertinent properties of food products, by developing models to describe the fundamental phenomena of food drying and by testing the models at the laboratory scale. These data will be used to develop strategies for reducing the energy requirements of food drying. Progress during this quarter has been made on Task 1 Literature Review, Task 2 Analytical Techniques, Task 4 Construction of Lab-Scale Dryer and Task 5 Drying Model Development.

15358 (DOE/ID/12608–T3) **Design and control of energy efficient drying processes with specific reference to foods: Technical progress report, July 1, 1986–September 30, 1986: Literature review.** Franzen, K.; Liang, H.; Litchfield, B.; Murakami, E.; Nichols, C.; Wannanan, K.; Miles, G.; Okos, M. Purdue Univ., Lafayette, IN (USA). Oct 1986. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG07-85ID12608. Order Number DE91010708. Source: OSTI; NTIS; GPO Dep.

The overall objective of this project is to perform fundamental studies in the area of food drying. This objective will be accomplished by performing studies to determine the pertinenet properties of food products, by developing models to describe the fundamental phenomena of food drying and by testing the models at the laboratory scale. These data will be used to develop strategies for reducing the energy requirements of food drying. Task 1 the Literature Review, Task 2 Analytical Techniques, and Task 6 The Food Properties Test Plan has been completed. Progress has been made on Task 5 Drying Model Development and Task 7 Laboratory Dryer studies.

15359 (DOE/ID/12608–T4) **Design and control of energy efficient drying processes with specific reference to foods: Technical progress report, October 10, 1986–December 31, 1986.** Franzen, K.; Liang, H.; Litchfield, B.; Murakami, E.; Nichols, C.; Wannanan, K.; Miles, G.; Okos, M. Purdue Univ., Lafayette, IN (USA). Dec 1986. 59p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG07-85ID12608. Order Number DE91010709. Source: OSTI; NTIS; GPO Dep.

The overall objective of this project is to perform fundamental studies in the area of food drying. This objective will be accomplished by performing studies to determine the pertinent properties of food products, by developing models to describe the fundamental phenomena of food drying and by testing the models at the laboratory scale. These data will be used to develop strategies for reducing the energy requirements of food drying. Task 1, Literature Review; Task 2, Analytical Techniques; and Task 6, The Food Properties Test Plan has been completed. Progress has been

made on Task 5, Drying Model Development and Task 7, Laboratory Dryer studies; Task 8, Food Properties Studies and Task 9, Recommendation.

15360 (DOE/ID/12608–T5) **Design and control of energy efficient drying processes with specific reference to foods: Quarterly report, July 1, 1987–October 1, 1987.** Franzen, K.; Kim, M.; Liang, H.; Murakami, E.; Narsimhan, G.; Okos, M.; Singh, R.; Waananen, K. Purdue Univ., Lafayette, IN (USA). 10 Oct 1987. 22p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG07-85ID12608. Order Number DE91010710. Source: OSTI; NTIS; GPO Dep.

Work on Phase 2 of the drying project was started during the last quarter. Progress on Task 10 (Revision of Drying Models) included a review of fundamental drying theory, and an investigation of experimental methods to determine model coefficients. Models for a drum dryer were also analyzed this quarter. Progress on Task 11 (Dryer Studies) included an analysis of a pressurized drying chamber, and installation of a vacuum drum dryer. Further work is needed to prepare both systems for experimental drying studies. Progress on Task 12 (Food Quality Studies) included collection of data on browning and vitamin A degradation in nonfat dried milk. Analysis and interpretation of the data are planned for the next quarter. Thermal property tests on porous food materials were also investigated during the past quarter. Progress on Task 13 (Recommendations/Strategies for Dryer Design and Control) included a review of dryer control strategies presented in the literature. A survey of available sensors for dryer control is planned for the next quarter.

15361 (DOE/ID/12608–T6) **Design and control of energy efficient drying processes with specific reference to foods: Quarterly report, October 1, 1987–January 1, 1988.** Franzen, K.; Kim, M.; Liang, H.; Murakami, E.; Narsimhan, G.; Okos, M.; Singh, R.; Waananen, K. Purdue Univ., Lafayette, IN (USA). 15 Jan 1988. 51p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG07-85ID12608. Order Number DE91010711. Source: OSTI; NTIS; GPO Dep.

This report describes research on the following topics: revision of drying models; dryer studies; food quality studies; and recommendations/strategies for dryer design and control.

15362 (DOE/ID/12608–T10) **Design and control of energy efficient drying processes with specific reference to foods: Quarterly report, October 1–December 31, 1988.** Kim, M.; Liang, H.; Murakami, E.; Narsimhan, G.; Okos, M.: Singh, R.; Waananen, K.; Xiong, X. Purdue Univ., Lafayette, IN (USA). 17 Jan 1989. 54p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG07-85ID12608. Order Number DE91010712. Source: OSTI; NTIS; GPO Dep.

This paper describes research on the following topics: revision of drying models; dryer studies; food quality studies; recommendations/strategies for dryer design and control; and moisture mobility and interaction in foods.

15363 (IAEA-TECDOC–576) **Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.** International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. 232p. (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

The amount of post-harvest losses of food is considered to be highest on the African continent. As a result, increasing numbers of countries in Africa are suffering from problems of hunger and malnutrition, which range from chronic to acute. Food irradiation could play an important role in reducing the high rate of food losses especially in the case of food grain, root crops and dried food in this continent provided that proper infrastructure to employ this technique could be identified. Irradiation could contribute positively to the safety of food from microbiological and parasitic infection. A panel of experts participated at the round table discussion to assess the potential application of the technology in Africa. Some of the items for which technical feasibility has been established for food irradiation preservation include yams, onions, potatoes, maize, millet, sorghum, cowpeas and other pulses, cocoa beans, spices (pepper) and condiments, meat and poultry, fish and fishery products, animal feed, etc. In considered the local demand, a suitable choice of the type and size of the facility should be made. The design should allow up-grading in both size and automated operation to meet future expansion of the existing facility, but small commercial scale facilities, of low cost, should be considered to start with. Whatever type of equipment chosen, (whether Gamma or Electron Beam) safety, reliability, maintainability, and simplicity of operation should be of major consideration. It is recognized that for a project to be concluded on a reasonable schedule, technology transfer and training should be incorporated into the complete package. In addition back-up technical infrastructure in the country should be strengthened. The effective procedures demonstrated in a number of countries for performing consumer acceptance studies on irradiated foods, should be adopted in a slightly modified form adapted to the different target populations. (Abstract Truncated)

15364 (IAEA-TECDOC–576, pp. 13-23) **Radiation disinfestation of foods.** Ahmed, M. (Joint FAO/IAEA Div. of Nuclear Techniques in Food and Agriculture, Vienna (Austria). Food Preservation Section). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

Loss of foods in storage due to infestation of insects varies from 10-25%. The fumigation is being used to control stored product pests in storage. The use of toxic chemicals to control insects has been questioned due to their toxic residues. There is a need for supplementary method to protect food from loss in storage. Irradiation has been found to be one of the methods which could effectively be used for disinfestation of stored food products. Considerable research and development work has been carried out which shows that insects in all their development stages could be disinfested at a dose of 0.50 kGy. Low dose of radiation has also been found to control the insects of quarantine importance. After disinfestation by radiation the products have to be protected from re-infestation. Experimental results on packages studies show that proper packaging material could be developed to check re-infestation of insects after irradiation treatment. Therefore, irradiation is an effective physical method which could be used for the disinfestation of all stored food products. (author). 10 refs.

15365 (IAEA-TECDOC–576, pp. 25-39) **Disinfestation of stored grain by irradiation.** Boisseau, P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Service de Radioagronomie). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (In French). (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

The loss of grain following the harvest can reach 40% in some tropical regions where losses during storage have several causes, with serious consequences as regards both quantity and quality. The control methods currently used are physical or chemical. The main advantage of chemical methods is their effectiveness, but the use of insecticides is limited by the toxicity of some of the substances involved, the presence of toxic residues and the emergence of resistant strains. The technique of irradiation consists in exposing grain to ionizing radiation which destroys larvae. The advantage of this technique is its capacity for continuous treatment of large quantities of grain in a highly automated manner without leaving residues or causing environmental contamination. The energy cost of the treatment is low. The main constraint on this treatment is the necessity of preventing any subsequent re-infestation by the pests. A grain disinfestation facility equipped with electron accelerators has been in industrial operation in Odessa since 1983 with a processing capacity of 400 t/h. The savings

achieved by using the irradiation process make such a facility pay off within a few years. Electron accelerators appear to be more economical for the processing of large tonnages in bulk, whereas a gamma irradiator seems more suitable for processing grain in sacks. (author). 34 refs, 6 figs, 4 tabs.

15366 (IAEA-TECDOC–576, pp. 41-52) **Present status of research activities in food irradiation technology in Nigeria.** Olorunda, A.O. (Ibadan Univ., Ibadan (Nigeria). Dept. of Food Technology); Aworh, O.C.; Oguntimein, G.B.; Oguntunde, A.O. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

The present and future status of research activity in food irradiation technology in Nigeria has been highlighted with particular emphasis on the work at the University of Ibadan. Work done to date has clearly demonstrated that food irradiation technology has a lot of promise in extending the shelf life of many staple foods in Nigeria. Future research programmes in food irradiation technology would be directed towards establishing the commercial feasibility of the process. (author). 21 refs, 1 fig., 1 tab.

15367 (IAEA-TECDOC–576, pp. 53-79) **Technology and economic interest of food irradiation, illustrated by a range of facilities.** Erhart, F. (Societe Generale pour les Techniques Nouvelles (SGN), 78 - Saint-Quentin-en-Yvelines (France)); Keraron, Y.; Bajon, A. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (In French). (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

The industrial irradiation of food has specific procedural, technological and economic features which distinguish it from industrial irradiation in general. The resources for implementation of this technique, both the irradiation equipment itself and the associated installations, will therefore necessarily be different from those currently used for industrial irradiation. A range of pallet irradiators for numerous applications has been suggested by a French engineering firm. The proposed equipment is simple, can be adapted to individual needs and can deal with increasing production, whether in specialized or multipurpose use. Realistic estimates of investment costs are given for several models from the range. Operating costs are estimated for two applications to African food products, namely treatment of the yam to inhibit sprouting and disinfestation of tropical fruits such as the papaya. It is shown that the costs are highly sensitive to variations in the quantities treated. The economic interest of the treatments is assessed, taking into account problems that arise with the organization of outlets for these products. (author). 14 refs, 5 figs, 4 tabs.

15368 (IAEA-TECDOC–576, pp. 81-89) **Low cost small commercial scale irradiation facility for technology transfer in non-industrialized countries.** Lapidot, M. (Israel Atomic Energy Commission, Soreq Nuclear Research Center, Yavne (Israel). Radiation Technology Div.); Saveanu, S. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

A low cost (30-50% that of equivalent commercial facilities), versatile, small industrial food irradiator has been conceptually developed to allow economically feasible introduction of food irradiation technology in non-industrialized countries. Its technical and economic characteristics are presented in tabular form. (author). 7 tabs.

15369 (IAEA-TECDOC–576, pp. 109-123) **Prospects for food irradiation in Nigeria.** Olorunda, A.O. (Ibadan Univ., Ibadan (Nigeria). Dept. of Food Technology); Aworh, O.C. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

A number of potential applications of food irradiation in Nigeria as demonstrated in Laboratory studies have been highlighted. These include: inhibition of sprouting and extension of the shelf life of yams and onions; control of mouldiness in cocoa beans and cowpea; and decontamination of dried ground red pepper. With these applications as a starting point, the next approach is to move from the technical feasibility stage to the stage that would lead to commercialization. What this paper has attempted to do is to look into the economic, technical and other considerations that would lead to a successful introduction of Food Irradiation Technology in Nigeria. (author). 33 refs, 1 fig., 6 tabs.

15370 (IAEA-TECDOC–576, pp. 125-128) **Food irradiation and its prospects in developing countries of Africa.** Roushdy, H.M. (Atomic Energy Authority, Cairo (Egypt)). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

Egypt has developed a research and development programme in various fields of nuclear science including food irradiation. This paper describes the facilities available and research and development activities carried out on food irradiation in Egypt. (author).

15371 (IAEA-TECDOC–576, pp. 129-140) **Constraints on and prospects for food irradiation in Africa.** Thomas, D.B. (Centre Regional Africain de Technologie, Dakar (Senegal)); Kane, O.; Fiagan, Y.; Timoulali, M. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (In French). (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

The extent of post-harvest losses in Africa is sufficient reason for the application of appropriate preservation methods to gain maximum benefit from food production. Irradiation is one possibility worth considering, in view of its capacity to destroy biological spoiling agents (e.g. pathogenic microorganisms, insects, etc.) and to inhibit certain catabolic processes involved in the deterioration of various foodstuffs. This paper shows, however, that there are still various constraints on the development and application of irradiation in Africa. These include psychological barriers, the lack of socio-economic feasibility studies, the lack or insufficiency of qualified staff, and economic and financial restrictions in the majority of countries. Geographical and infrastructural constraints on the installation of irradiation units should also be considered, as well as the legal framework to regulate the marketing of irradiated food products. Despite these various constraints, the advantages of irradiation for preserving foodstuffs, suggests that it should have great potential for commercial use in Africa. This should, however, be preceded by a stage of active experimentation on local products and an information campaign directed at potential promoters and consumers. Information must be made available to the general public in order to attenuate fears relating to nuclear technology. The development of a pool of staff specialized in radiation processing and its applications is also a prerequisite. Finally, attention is drawn to the programme to be implemented by the Regional African Technology Centre, in co-operation with the International

Atomic Energy Agency, to promote the application of irradiation in Africa. (author). 11 refs, 1 tab.

15372 (IAEA-TECDOC–576, pp. 141-144) **Food irradiation and the detection of irradiated products: Scenarios and prospects in Senegal.** Diatta, C.S. (Cheikh Anta Diop Univ., Dakar (Senegal). Inst. de Technologie Nucleaire Appliquee). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (In French). (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

Food irradiation involves complex physical and chemical processes requiring the establishment of research programmes specific to the installations. Hence, it cannot be considered a process which is fully understood. Therefore, bearing in mind its effectiveness in dealing with bacteriological contamination that can accelerate food deterioration, an irradiation programme should be set up in Senegal to combine research with selective treatment of foodstuffs. Such a programme is under consideration. (author).

15373 (IAEA-TECDOC–576, pp. 145-150) **Foodborne disease in Africa and irradiation as a potential control technique.** Roberts, T. (Department of Agriculture, Washington, DC (USA). Economic Research Service); Murrell, D. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

Foodborne disease appears to be increasing worldwide. Both the first and second World Congresses on Foodborne Infections and Intoxications supported irradiation of food as a way to reduce foodborne disease. Doses required to kill or control pathogenic microorganisms and parasites are investigated. Meats are the primary source of many foodborne diseases. Several potential uses for pathogen control are technically feasible, but care must be taken to avoid recontamination after irradiating and packaging must be used which will not permit growth of botulism. (author). 10 refs, 5 tabs.

15374 (IAEA-TECDOC–576, pp. 151-168) **Technology and economy of radiation facilities for food processing.** Laizier, J. (CEA, 75 - Paris (France). Projet Ionisation). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (In French). (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

Till 1980, almost all the available experience on the technology and economy of radiation facilities was based on radiation sterilization and on the chemical applications. The needs related to food processing are quite different, and new analyses and concepts were then emerging progressively after the JEFCI of 1980, which are worth describing. From the technical point of view, important progress was achieved for optimizing the gamma facilities in view of their intended use, and for designing fully industrial facilities of small size. On the other hand, the possibility appeared of using high energy electron beams in good economical conditions. From the economical point of view, it now appears possible to estimate realistic processing costs with satisfaction. Examples show that this possibility does exist in the whole range of food processing, in spite of the very wide range of economical conditions to which they are corresponding. (author). 11 figs.

15375 (IAEA-TECDOC–576, pp. 177-188) **Radiation disinfestation of grains and cocoa beans.** Appiah, V. (Ghana Atomic Energy Commission, Legon, Accra (Ghana). Dept. of Biology, Food and Agriculture). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

A series of experiments has been performed by Ghanaian scientists from 1977 to 1987 to evaluate the seriousness of infestation and to establish effective doses for radiation disinfestation against insects and fungi which cause deterioration in grains and cocoa beans. Supporting investigations have been done on the effect of radiation disinfestation on some quality parameters and wholesomeness of grains (with maize as the test grain) and cocoa beans. A minimum dose of 0.8 kGy was established for effective control of insects present in stored grains and cocoa beans. For the decontamination against fungi and yeasts, a combination of moist heat (85% RH) applied to 60 deg. C for 30 min followed by a dose of 4 kGy was effective for maize and moist heat (85% RH) applied 80 deg. C and a dose of 4 kGy was recommended for cocoa beans. No significant difference was found between the organoleptic qualities of the products from maize and cocoa that had been treated with moist heat and radiation and the untreated samples. The cooling (solidifying) curves of cocoa butter prepared from untreated and treated cocoa beans were very similar. Irradiated cocoa beans were found to be wholesome. The prospects of radiation disinfestation of grains and cocoa beans have also been discussed. (author). 27 refs, 4 tabs.

15376 (IAEA-TECDOC–576, pp. 189-207) **Irradiation as a process in eliminating pathogens in Ghanaian smoked tuna.** Appiah, V. (Ghana Atomic Energy Commission, Legon, Accra (Ghana). National Nuclear Research Inst.); Nketsia-Tabiri, J.; Gbedemah, C.M.; Melfah, P.T. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

The hygienic quality of Ghanaian smoked tuna was determined microbiologically by examining samples obtained from the local market. Escherichia coli was present in 30% of the samples examined; Staphylococcus aureus was prevalent in 80% of the samples. The microorganisms present were predominantly bacteria, moulds and yeasts occurring occasionally in low concentrations. Freshly smoked tuna were irradiated at doses 0, 1.0, 2.0, 3.0, and 4.0 kGy and subjected to organoleptic evaluation for the colour, taste and texture. The mean scores for colour, taste and texture were beyond the borderline for acceptability. The doses applied did not cause any significant change in the organoleptic quality of smoked tuna. Smoked tuna of low and high salt concentrations were irradiated at the doses 0, 1.0, 2.0, 3.0, and 4.0 kGy. One batch of the treated fish was stored in a refrigerator (5-10 deg. C) and the other at ambient (25-28 deg. C). They were examined at intervals for organoleptic and microbiological quality. The shelf-life of smoked tuna with low salt content was extended by 3 days when irradiated at 3.0 kGy and that of high salt content for 6 days. Cold storage delayed spoilage and products were in good condition for more than 12 days of storage. A number of packaging materials were evaluated for the packaging of irradiated smoked tuna. Paper and vacuum sealed polythene were found to be better. Irradiated smoked tuna was transported to Kumasi (250 km), analysed and the results compared to that of a batch kept in the laboratory. Transportation was found not to affect the irradiated packaged fish significantly. (author). 20 refs, 5 figs, 8 tabs.

15377 (IAEA-TECDOC–576, pp. 169-175) **Consumer acceptance and public education on food irradiation.** Lapidot, M. (Israel Atomic Energy Commission, Soreq Nuclear Research Center, Yavne (Israel). Radiation Technology Div.). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990.

(CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

Tests and polls of consumer acceptance of irradiated foods, performed over the past 25 years, are briefly reviewed arriving at some general conclusions regarding the factors contributing towards positive results. Also reviewed are claims of "organizations" opposing acceptance of irradiated foods and the responses to these claims. The activities of the international bodies (FAO, IAEA and WHO) in generating information for public education are briefly described. (author). 9 refs, 1 tab.

15378 (IAEA-TECDOC–576, pp. 209-222) **Yams preservation by irradiation in Cote d'Ivoire.** Kodia, A.A. (Abidjan Univ., Abidjan (Cote d'Ivoire). Lab. de Radiometrie); Kouadio, K.G. International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (In French). (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

The present work deals with the effect of gamma irradiation on sprouting, loss of weight, respiration, proteins, total sugars, enzymes, organoleptic properties, and on consumer acceptance of irradiated yams. Three local varieties of yams have been chosen for this study because they are the most appraised in the market. (author). 12 refs, 6 figs, 7 tabs.

15379 (IAEA-TECDOC–576, pp. 223-229) **Prospects for food irradiation in Algeria.** Boussaha, A. (Haut Commissariat a la Recherche, Algiers (Algeria). Centre d'Etudes Nucleaires et Solaires). International Atomic Energy Agency, Vienna (Austria); Food and Agriculture Organization of the United Nations, Rome (Italy). Dec 1990. (CONF-880214–: Seminar for developing countries in Africa on food irradiation, Dakar (Senegal), 15-19 Feb 1988). In *Food irradiation for developing countries in Africa: Proceedings of an international seminar held in Dakar, Senegal, 15-19 February 1988.* 232p. Order Number DE91624594. Source: OSTI; NTIS (US Sales Only); INIS.

The average annual production of potatoes in Algeria is approximately 80,000-1,000,000 tonnes. Loss in potatoes in summer months is high due to lack of storage place. Estimated production of onion is 200,000 to 250,000 per annum. At least 25% of the production needs to be stored for off-season consumption. The average annual date production is 200,000 tonnes. The dates are infested with insects. Fumigation has been practised with limited results. Irradiation studies have been carried out to control sprouting of potatoes and onions. It is proposed that irradiation disinfestation of dates will also be carried out in Algeria. Economic feasibility studies for the establishment of a multi-purpose irradiator treating potatoes, onions and medical products have been carried out. It was found that an establishment of a commercial irradiation facility would be feasible in Algeria to treat food and medical products. (author). 4 tabs.

15380 (INIS-mf–12806, pp. 336-339) **Detection of termite infestation.** Easey, J.F. (Australian Atomic Energy Commission Research Establishment, Lucas Heights (Australia)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Over the past 10 years the Australian Atomic Energy Commission has had a program of research into the use of radioisotope techniques for studying termite infestations. The studies have been divided between two aspects of termite behaviour: their behaviour in a natural environment, and their behaviour in an urban environment where they co-exist with man and have to cope with his attempts to disturb or eradicate them. Scandium-46 oxide was incorporated into a sawdust-agar gel mixture packed into a hole drilled in wood dowelling. Later lanthanum 140 in a diethylenetriaminepentaacetic acid complex was used, both in the natural environment and in surveys of historic buildings in Sydney. Other termites will accept a bait made from agar gel into which either gold-190 colloid or iodine-131 iodide has been incorporated.

15381 (INIS-mf–12806, pp. 324-328) **Food irradiation and its application to Pacific Basin countries.** Kawabata, T. (National Inst. of Health, Tokyo (Japan)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

Food irradiation is gaining increasing recognition as a physical method of food preservation characterized by less energy consumption. Several important breakthroughs in food irradiation have been made in recent years. There is renewed industrial interest in food irradiation in various countries, especially in the developing countries of Asia and the Pacific. This paper discusses several topics on recent research and development work in food irradiation with special reference to the Asian Regional Cooperative Project on Food Irradiation.

15382 (ORNL/FTR–3874) **[Enzyme use in the Jute Industry]: Foreign trip report, November 26, 1990–December 27, 1990.** Niyogi, S.K. Oak Ridge National Lab., TN (USA). 15 Mar 1991. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91009642. Source: OSTI; NTIS; GPO Dep.

This report covers my official visit to the Indian Jute Industries' Research Association (IJIRA), Calcutta, India. The visit lasted a little over two weeks, including two trips to three jute mills outside Calcutta and a one-day visit to the library of the Indian Institute of Chemical Biology, Calcutta. The report describes the applications of enzymes (derived from a moldy wheat bran extract) in upgrading the jute fiber and in enhancing the quality of tamarind kernel powder used for sizing of jute. The various methodological developments in these processes are discussed in detail along with suggestions for possible improvements. The report also describes the visits to the jute mills where enzyme applications are being made. Interactions with the IJIRA research staff are described in detail. My contributions to the Project are described along with specific recommendations for future research.

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

5601 Radiation Effects

Refer also to citation(s) 15439, 15796

15383 (ANL/CP–71416) **Protection by WR-151327 against late-effect damage from fission-spectrum neutrons.** Grdina, D.J. (Argonne National Lab., IL (USA)); Wright, B.J.; Carnes, B.A. Argonne National Lab., IL (USA). [1990]. 12p. Sponsored by USDOE, Washington, DC (USA); National Cancer Inst., Bethesda, MD (USA). DOE Contract W-31109-ENG-38. Grant CA-37435. (CONF-9011167–3: International colloquium on neutron radiation biology, Rockville, MD (USA), 5-7 Nov 1990). Order Number DE91010568. Source: OSTI; NTIS; INIS; GPO Dep.

Considerable effort has been expended to develop chemical agents capable of modifying radiation-induced damage to biological systems. The authors describe here differences in the radioprotective effect of WR-151327, depending on the sex of the animal and the post-irradiation time interval considered. The greatest effect in female animals is prior to 805 days post irradiation. The greater protection in male animals is seen during the time increment following 850 days after irradiation. While it is difficult at present to ascribe these effects to a particulate model, it is suggestive that hormonal factors may play a role in aminothiol protection against radiation-induced life shortening and concomitant tumor induction in the $B6CF_1$ hybrid mouse system. With respect to subsequent tumor induction, their preliminary findings to be published elsewhere

suggest that tumors of lymphoreticular origin are the class of tumors most affected by the administration of a radioprotector prior to irradiation. 23 refs., 4 figs.

15384 (BfS-ISH-142/90) **Underlying data for derived emergency reference levels. Characterization of critical population groups with special consumption habits in Bavaria.** Burkhardt, J.; Lux, D. Bundesamt fuer Strahlenschutz, Neuherberg (Germany, F.R.). Inst. fuer Strahlenhygiene. Sep 1990. 75p. Order Number DE91764959. Source: OSTI; NTIS (US Sales Only); INIS.

Among the dose-relevant products, raw milk was the most critical food item for self-supporters during the first 1-2 years after Chernobyl. The relatively high body burden of radiocesium, measured in the group of hunters, can be explained by the fact that large amounts of contamined game are consumed. With respect to internal contamination, mushroom-eaters rank in an intermediate position. The mushroom-eaters reacted to the results from the first whole-body-measurements with special caution by selecting less contaminated wild-mushrooms for meals and by avoiding highly contaminated species, such as Boletus badius. Additionally self-supporters obtain about 75% of dose-relevant foodstuffs from the region. (DG).

15385 (EMO-1031) **Reconstruction of dose equivalents to the public from the ^{60}Co Irradiator Facility at the Laboratory for Energy-Related Health Research.** Chapman, T.E.; Scherpelz, R.I. Pacific Northwest Lab., Richland, WA (USA). Environmental Management Operations. Mar 1991. 51p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. Order Number DE91010126. Source: OSTI; NTIS; INIS; GPO Dep.

Because of the uncertainties associated with the dose equivalents received by the public, the DOE has tasked Environmental Management Operations (EMO), as part of the LEHR Environmental Restoration project commissioned by DOE, to reconstruct the dose equivalents received by the public adjacent to the LEHR site. The purpose of this study was to determine the potential radiation dose equivalents received by individuals in publicly accessible areas and to provide estimates of the associated risks to these individuals from the outdoor irradiations. EMO has reconstructed the radiation dose equivalent rates to the offsite areas using actual environmental radiation monitoring data augmented by Monte Carlo computer modeling of the radiation dose equivalent rates where necessary. This report describes the irradiator and adjacent areas, available environmental radiation data, the computer modeling and dose equivalent rate projections, occupancy determinations, and reconstructed dose equivalents. A risk factor is estimated for each of the dose equivalents calculated for the public. Traditional units are used throughout this report rather than SI (metric) units for reasons of clarity. 4 refs., 3 figs., 6 tabs.

15386 (INIS-SU-210, pp. 664) **Biological dosimetry of fluorographic examination of chest.** Demin, V.T. (Ministerstvo Zdravookhraneniya Ukrainskoj SSR, Kiev (Ukrainian SSR)); Demina, Eh.A.; Chebotarev, E.E.; Tereshchenko, V.M.; Rudoj, V.M. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259--: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CHROMOSOMAL ABERRATIONS/biological dosemeters; CHROMOSOMAL ABERRATIONS/lymphocytes; CELL CULTURES; CHEST; LYMPHOCYTES; FLUOROSCOPY; MAN; PHANTOMS; PHOTOGRAPHIC FILMS; RADIATION DOSE DISTRIBUTIONS; TISSUE-EQUIVALENT MATERIALS

15387 (INIS-SU-210, pp. 666-667) **Lymphocytes of peripheric blood as an indicator of state of irradiated body hemopoiesis.** Kalinin, N.L. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259--: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BLOOD FORMATION/biological radiation effects; LYMPHOCYTES/biological indicators; CELL PROLIFERATION; CHROMOSOMAL ABERRATIONS; IRRADIATION; LYMPHOCYTES

15388 (INIS-SU-210, pp. 667-668) **Micronuclear test as indicator of radiation injury.** Kolyubaeva, S.N. (Tsentral'nyj Nauchno-Issledovatel'skij Rentgeno-Radiologicheskij Inst., Leningrad (USSR)); Myasnikova, L.V.; Raketskaya, V.V. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259--: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CELL NUCLEI/biological indicators; CELL NUCLEI/lymphocytes; BIOLOGICAL RADIATION EFFECTS; BLOOD; LYMPHOCYTES; DOSE-RESPONSE RELATIONSHIPS; IN VITRO; IN VIVO; IRRADIATION; LETHAL RADIATION DOSE; MAN; RATS

15389 (INIS-SU-210, pp. 671-672) **Radiobiological analysis of base of biological indication of radiation injuries.** Mazurik, V.K. (Institut Biofiziki, Moscow (USSR)). AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259--: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RADIATION INJURIES/biological indicators; BLOOD FORMATION; CYTOLOGY; DOSE-RESPONSE RELATIONSHIPS; GENETIC EFFECTS; IN VITRO; IONIZING RADIATIONS; LOW DOSE IRRADIATION; MAN

15390 (INIS-SU-210, pp. 673-674) **Changes in contact properties of blood cells in acute radiation pathology.** Nikolaevskaya, L.V. (Tsentral'nyj Nauchno-Issledovatel'skij Rentgeno-Radiologicheskij Inst., Leningrad (USSR)). AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259--: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BLOOD CELLS/biological indicators; ADHESION; BONE MARROW CELLS; CELL CULTURES; CELL MEMBRANES; DIAGNOSIS; EARLY RADIATION EFFECTS; GAMMA RADIATION; RADIATION SYNDROME

15391 (INIS-SU-210, pp. 674-675) **Nonidentificated radiosensitive factor of animal and human blood at initial period of radiation injuries.** Potemkin, L.A. (Institut Biofiziki, Moscow (USSR)); Mazurik, V.K. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259--: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BLOOD CELLS/biological indicators; BLOOD PLASMA/biological indicators; BLOOD CHEMISTRY; DOGS; EARLY RADIATION EFFECTS; IN VITRO; IONIZING RADIATIONS; MAN; RADIATION DOSES

15392 (INIS-SU-210, pp. 677) **Changes in thermohemolysis parameters of human erythrocytes subjected to irradiation.** Slobozhanina, E.I. (AN Belorusskoj SSR, Minsk (Byelorussian SSR). Inst. Fotobiologii); Yamajkina, I.V.; Kozlova, N.M.; Chernitskij, E.A. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259--: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CHERNOBYLSK-4 REACTOR/environmental impacts; CHERNOBYLSK-4 REACTOR/populations; ERYTHROCYTES/biological indicators; CELL MEMBRANES; POPULATIONS; CONTROLLED AREAS; DELAYED RADIATION EFFECTS; ERYTHROCYTES; HEMOLYSIS; IONIZING RADIATIONS; LOW DOSE IRRADIATION; RADIATION INJURIES; REACTOR ACCIDENTS; SIDE EFFECTS

15393 (INIS-SU-210, pp. 682-683) **Effect of combined ionizing and laser radiations on survival rates of haploid and diploid yeasts cells.** Avakyan, Ts.M. (Erevanskij Fizicheskij Inst., Erevan (USSR)); Dzhanpoladyan, N.L.; Simonyan, N.V.; Stepanyan, L.G. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian).

(CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. PLANT CELLS/biological radiation effects; YEASTS/laser radiation; YEASTS/x radiation; DIPLOIDY; HAPLOIDY; RESPONSE MODIFYING FACTORS; STRAND BREAKS; SURVIVAL CURVES; YEASTS

15394 (INIS-SU–210, pp. 683-684) **Modification of radiation injuries by electromagnetic radiation of ultrahigh frequency.** Alipov, E.D. (Moskovskij Inzhenerno-Fizicheskij Inst., Moscow (USSR)); Belyaev, I.Ya.; Edneral, D.I. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CHROMOSOME BREAKAGE/ionizing radiations; CHROMOSOME BREAKAGE/radiowave radiation; BIOLOGICAL RADIATION EFFECTS; CREPIS; DNA REPAIR; DROSOPHILA; ESCHERICHIA COLI; MHZ RANGE 100-1000; RESPONSE MODIFYING FACTORS

15395 (INIS-SU–210, pp. 665-666) **On possibilities of use of chromosomal aberrations for evaluation of state of cereals in radioactive contamination of crops.** Dikarev, V.G.; Ivasenko, E.I.; Dikareva, N.S.; Filipas, A.S. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CHROMOSOMAL ABERRATIONS/biological dosemeters; CHROMOSOMAL ABERRATIONS/meristems; MERISTEMS/leaves; CEREALS; CESIUM 137; MERISTEMS; COBALT 60; DOSE-RESPONSE RELATIONSHIPS; GAMMA RADIATION; GENETIC RADIATION EFFECTS; LEAVES; PLANT CELLS; RADIATION DOSES; TIME DEPENDENCE

15396 (INIS-SU–210, pp. 670-671) **Regularities and molecular mechanisms of postradiation thymidinemia.** Konov, A.V. (Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii); Podgorodnichenko, V.K.; Skoraya, L.A.; Ivannik, B.P.; Sin'kova, R.V. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. THYMIDINE/biological indicators; THYMIDINE/blood; THYMIDINE/urine; BIOLOGICAL RADIATION EFFECTS; CATABOLISM; DOSE-RESPONSE RELATIONSHIPS; IRRADIATION; LABORATORY ANIMALS; THYMIDINE; BLOOD; URINE; THYMOCYTES; TIME DEPENDENCE

15397 (INIS-SU–210, pp. 676) **Modification of small intestine radiation injuries by radioprotective substances of different chemical classes.** Rasina, L.N. (Ural'skij Politekhnicheskij Inst., Sverdlovsk (USSR)); Chupakhin, O.N.; Novikova, A.P. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. STEM CELLS/radioprotective substances; STEM CELLS/small intestine; ANIMALS; CHEMICAL RADIATION EFFECTS; GAMMA RADIATION; LIFE SPAN; SUPRALETHAL IRRADIATION; THIAZOLES; WHOLE-BODY IRRADIATION

15398 (INIS-SU–210, pp. 678) **Micronuclear induction in mice somatic cells exposured in region of Chernobyl Nuclear Power Plant.** Chekhovich, A.V. (AN SSSR, Moscow (USSR). Inst. Obshchej Genetiki); Sycheva, L.P. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CHERNOBYLSK-4 REACTOR/genetic radiation effects; CHERNOBYLSK-4 REACTOR/reactor accidents; ACUTE IRRADIATION; BIOLOGICAL INDICATORS; BONE MARROW CELLS; CHRONIC IRRADIATION; DOSE RATES; ERYTHROCYTES; GAMMA RADIATION; LIVER CELLS; MICE; NUCLEOLI; RADIATION DOSES

15399 (INIS-SU–210, pp. 679-680) **Action of ^{40}K in low doses on biological active animal skin locuses.** Shevchenko, I.N. (Kievskij Gosudarstvennyj Univ., Kiev (Ukrainian SSR)); Baraboj, V.A.; Prokopets, G.A. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. POTASSIUM 40/skin; SKIN/low dose irradiation; SKIN/morphological changes; BIOLOGICAL FUNCTIONS; BIOLOGICAL RADIATION EFFECTS; MICE; SKIN; RADIATION SOURCES

15400 (INIS-SU–210, pp. 680-681) **Analysis of DNA blood plasma as a test of early diagnosis of radiation injuries.** Sherlina, S.S. (Voenno-Meditsinskaya Akademiya, Leningrad (USSR)); Belokhvostov, A.S.; Vasil'eva, I.N. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. DNA/biological indicators; DNA/blood plasma; BIOLOGICAL RADIATION EFFECTS; DNA; GAMMA RADIATION; RADIATION DOSES; RATS

15401 (INIS-SU–210, pp. 685) **Influence of structural factors on radioprotective activity of derivatives of 1-(3-hydroxyphenyl)-2-aminoethanol.** Alpatova, T.V. (Institut Biofiziki, Moscow (USSR)); Kovtun, V.Yu.; Klimova, A.D.; Kulinskij, V.I.; Yashchunskij, V.G. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RADIOPROTECTIVE SUBSTANCES/molecular structure; ALCOHOLS; AMINES; HYDROXY COMPOUNDS; LETHAL RADIATION DOSE; MICE; RADIATION EFFECTS; RADIATION PROTECTION; X RADIATION

15402 (INIS-SU–210, pp. 685-686) **Modification of acute radiation injuries by cytozares.** Andrushchenko, V.N. (Institut Biofiziki, Moscow (USSR)); Tencheva, V. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ANTIMITOTIC DRUGS/radioprotective substances; RESPONSE MODIFYING FACTORS/radiation injuries; ALCOHOLS; AMINES; CESIUM 137; GAMMA RADIATION; INTRAPERITONEAL INJECTION; MICE; RADIATION DOSES; RADIOSENSITIVITY; SURVIVAL CURVES; TIME DEPENDENCE

15403 (INIS-SU–210, pp. 687-688) **On the problem of possibility of simulating of chromosomal postradiation recovery after finishing of spontaneous repair: modifying action of thyroxine.** Antipenko, E.N. (Ministerstvo Zdravookhraneniya Ukrainskoj SSR, Kiev (Ukrainian SSR)); Timchenko, O.I. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BIOLOGICAL REPAIR/thyroxine; CHROMOSOMAL ABERRATIONS/biological repair; THYROXINE/response modifying

factors; THYROXINE; GENETIC RADIATION EFFECTS; HEPATECTOMY; IN VITRO; IN VIVO; LIVER CELLS; LYMPHOCYTES; RADIATION DOSES; RATS; WHOLE-BODY IRRADIATION; X RADIATION

15404 (INIS-SU–210, pp. 688-689) **Radiation protective properties of substituted imino-dihydrofurans and derivatives of propionic acid.** Afonina, T.D. (Permskij Gosudarstvennyj Univ., Perm (USSR)); Khutorskaya, E.Eh.; Vavilova, A.N.; Skvortsov, Yu.M. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RADIATION PROTECTION/amines; RADIATION PROTECTION/furans; RADIATION PROTECTION/propionic acid; GAMMA RADIATION; INTRAPERITONEAL INJECTION; LIFE SPAN; MICE; RADIATION DOSES; AMINES; FURANS; RESPONSE MODIFYING FACTORS; SURVIVAL CURVES

15405 (INIS-SU–210, pp. 691-692) **Use of dispersion silice and crownesters as a modifier of aminothioles and indolylalkylamines.** Bidzilya, V.A. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR)); Golovkova, L.P.; Beregovskaya, N.N.; Barkaya, V.S.; Bakaj, Eh.A. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RADIOPROTECTIVE SUBSTANCES/amines; RADIOPROTECTIVE SUBSTANCES/thiols; ACUTE IRRADIATION; FRACTIONATED IRRADIATION; HETEROCYCLIC COMPOUNDS; MICE; ORAL ADMINISTRATION; POLYETHYLENE GLYCOLS; RADIATION DOSES; AMINES; THIOLS; SILICON OXIDES

15406 (INIS-SU–210, pp. 692-693) **Peculiarities of radiomodifying action of derivatives of purine bases.** Vartanyan, L.P. (Tsentral'nyj Nauchno-Issledovatel'skij Rentgeno-Radiologicheskij Inst., Leningrad (USSR)); Krutovskikh, G.N.; Pustovalov, Yu.I.; Gornaeva, G.F.; Ivin, B.A.; Girshovich, M.Z. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. PURINES/radioprotective substances; INTRAPERITONEAL INJECTION; LETHAL RADIATION DOSE; MICE; PURINES; RADIOSENSITIVITY; SURVIVAL CURVES; WHOLE-BODY IRRADIATION; X RADIATION

15407 (INIS-SU–210, pp. 693-694) **Changes in radiosensitivity of animals under conditions of fractionated gamma radiation and use of radioprotective substances and immunomodulators.** Vasin, M.V.; Semenova, L.A.; Chernov, Yu.N. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RADIOSENSITIVITY/radioprotective substances; FRACTIONATED IRRADIATION; GAMMA RADIATION; MICE; RADIATION PROTECTION; RADIOSENSITIVITY; SURVIVAL CURVES

15408 (INIS-SU–210, pp. 695-697) **Radioprotective substances and the theory of radioprotective effect.** Vladimirov, V.G. (Voenno-Meditsinskaya Akademiya, Leningrad (USSR)); Krasil'nikov, I.I. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RADIOPROTECTIVE SUBSTANCES/biochemistry; CHEMICAL PROPERTIES; RADIATION PROTECTION; BIOCHEMISTRY; RADIOSENSITIZERS

15409 (INIS-SU–210, pp. 697-698) **Use of mexamine liposome form in acute radiation injury.** Volchkov, V.A. (Tsentral'nyj Nauchno-Issledovatel'skij Rentgeno-Radiologicheskij Inst., Leningrad (USSR)); Mikhajlova, N.Ya.; Rozenberg, O.A. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. MEXAMINE/radiation injuries; CFU; INTRAVENOUS INJECTION; LIPOSOMES; MEXAMINE; MICE; RADIATION DOSES; SURVIVAL CURVES; WHOLE-BODY IRRADIATION

15410 (INIS-SU–210, pp. 698-699) **Action of hypoxic hypoxia used as nonspecific therapeutic measure in irradiated animals on cardiovascular and respiratory functional systems.** Gevorgyan, Eh.G. (Ministerstvo Zdravookhraneniya Armyanskoj SSR, Erevan (USSR). Sektor Radiobiologii). AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ANOXIA/cardiovascular system; ANOXIA/respiratory system; RADIATION INJURIES/response modifying factors; ANOXIA; BIOLOGICAL FUNCTIONS; LETHAL RADIATION DOSE; RATS; WHOLE-BODY IRRADIATION; X RADIATION

15411 (INIS-SU–210, pp. 699-700) **Influence of serotonin on reactivity of hypothalamovasopressynergetic system in ionizing radiation effect.** Gzirishvili, N.A. (AN Gruzinskoj SSR, Tbilisi (USSR). Inst. Fiziologii); Kabzinadze, K.G. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. HYPOTHALAMUS/biological radiation effects; HYPOTHALAMUS/serotonin; RADIOIMMUNOASSAY/vasopressin; HYPOTHALAMUS; SEROTONIN; RABBITS; RADIATION DOSES; RADIOIMMUNOASSAY; VASOPRESSIN; WHOLE-BODY IRRADIATION

15412 (INIS-SU–210, pp. 689-690) **Prospects for prophylaxis by beta-carotene of gonad radiation injuries.** Belyaev, I.K. (Institut Biofiziki, Moscow (USSR)); Zarajskij, A.V.; Vakulova, L.A. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RADIATION INJURIES/gonads; RADIATION INJURIES/radiation protection; ALGAE; ANIMALS; CAROTENOIDS; FUNGI; GONADS; RADIOPROTECTIVE SUBSTANCES; REPRODUCTION

15413 (INIS-SU–210, pp. 694-695) **Radioprotective effect of gaseous hypoxia in radiotherapy of human tumors.** Vajnson, A.A. (Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR). Onkologicheskij Nauchnyj Tsentr); Goldobenko, G.V.; Kosseh, V.A.; Khvorostenko, M.I. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. NEOPLASMS/anoxia; NEOPLASMS/radiotherapy; BIOLOGICAL RADIATION EFFECTS; DOSE-RESPONSE RELATIONSHIPS; FRACTIONATED IRRADIATION; NEOPLASMS; ANOXIA; RADIOTHERAPY; PATIENTS; RADIATION PROTECTION; RESPONSE MODIFYING FACTORS

15414 (INIS-SU–210, pp. 700-701) **Comparative chemical modification of cytogenetic effect during gamma and neutron irradiation of human lymphocytes of G_0 stage.** Golub, E.V. (Akademiya Meditsinskikh Nauk SSSR, Obninsk (USSR). Nauchno-Issledovatel'skij Inst. Meditsinskoj Radiologii); Bogatykh,

B.A. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. CHROMOSOMAL ABERRATIONS/enzyme inhibitors; CHROMOSOMAL ABERRATIONS/genetic radiation effects; LYMPHOCYTES/gamma radiation; LYMPHOCYTES/neutron beams; BIOCHEMICAL REACTION KINETICS; CELL CULTURES; CYCLOHEXIMIDE; LYMPHOCYTES; MAN; ORGANIC FLUORINE COMPOUNDS; RADIATION DOSES; STRAND BREAKS; URACILS

15415 (INIS-SU–210, pp. 704) **Research for new potential radioprotective substances among nitrogen containing derivatives of 1,4-naphthoquinone.** Drulle, A.Ya. (Latvijskij Gosudarstvennyj Univ., Riga (USSR)); Antipova, D.Yu.; Vulfa, L.Ya.; Belevich, G.V.; Dregeris, Ya.Ya. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RADIOPROTECTIVE SUBSTANCES/organic nitrogen compounds; AROMATICS; CELL MEMBRANES; PLANT CELLS; RADIATION DOSES; SURVIVAL CURVES; X RADIATION; YEASTS

15416 (INIS-SU–210, pp. 709-710) **Radioprotective action of thiazolines (evaluation with the position of hypothesis of endogenous background of radioresistance).** Zolotareva, L.T. (Moskovskij Gosudarstvennyj Univ., Moscow (USSR)); Goncharenko, E.N.; Fedoseev, V.M. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. SACCHAROMYCES/radiation protection; THIAZOLES/radioprotective substances; IONIZING RADIATIONS; PLANT CELLS; RADIOSENSITIZERS; SACCHAROMYCES; THIAZOLES

15417 (INIS-SU–210, pp. 701-702) **Modification of radiation injuries of stem blood formation cells of mice by cadmium ions and recombinated human interleukin-2.** Gracheva, N.I. (AN SSSR, Leningrad (USSR). Inst. Tsitologii). AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RADIOSENSITIVITY/cadmium compounds; RADIOSENSITIVITY/polypeptides; STEM CELLS/radiosensitivity; BLOOD FORMATION; INTRAPERITONEAL INJECTION; LETHAL IRRADIATION; MICE; RADIOSENSITIVITY; POLYPEPTIDES; SPLEEN COLONY FORMATION; X RADIATION

15418 (INIS-SU–210, pp. 702-703) **Influence of radioprotective substances on postradiation changes in cytochrome R-450 and aminopyrine-N-demethylase activity in microsomal liver fraction of rats.** Deev, L.I. (Moskovskij Gosudarstvennyj Univ., Moscow (USSR)); Akhalaya, M.Ya.; Khakimov, A.; Yarmak, O.D. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ENZYME ACTIVITY/aet; ENZYME ACTIVITY/gammaphos; ENZYME ACTIVITY/serotonin; BIOLOGICAL RADIATION EFFECTS; CYTOCHROME OXIDASE; AET; GAMMAPHOS; SEROTONIN; RADIATION DOSES; RATS; X RADIATION

15419 (INIS-SU–210, pp. 704-705) **Protection of intestine by total hypoxia in single and fractionated irradiation.** Zajtsev, A.V. (Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR). Onkologicheskij Nauchnyj Tsentr); Konoplyannikova, O.A.; Konoplyannikov, A.G.; Vajnson, A.A. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ANOXIA/response modifying factors; INTESTINES/radiation protection; ANOXIA; CLONE CELLS; CRYPT CELLS; FRACTIONATED IRRADIATION; GAMMA RADIATION; INTESTINES; MICE; RADIATION DOSES; RADIATION SYNDROME; SIDE EFFECTS; SURVIVAL CURVES; WHOLE-BODY IRRADIATION

15420 (INIS-SU–210, pp. 706-707) **Modification of radioprotective substances action with the help of surfactants.** Znamenskij, V.V. (Institut Biofiziki, Moscow (USSR)); Grechka, I.I.; Davidovich, Yu.A. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RADIATION PROTECTION/radioprotective substances; RADIATION PROTECTION/surfactants; CELL MEMBRANES; IONIZING RADIATIONS; MAMMALS; SURFACTANTS

15421 (INIS-SU–210, pp. 707-708) **Radioprotective effect of derivatives of mercaptoethylamines.** Znamenskij, V.V. (Institut Biofiziki, Moscow (USSR)); Kovtun, V.Yu.; Karimova, N.M.; Plakhotnik, V.M.; Ignatova, Yu.L. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. MEA/biochemistry; BIOLOGICAL RADIATION EFFECTS; GAMMA RADIATION; LETHAL RADIATION DOSE; MEA; BIOCHEMISTRY; MICE

15422 (INIS-SU–210, pp. 708) **Radioprotective properties of dervatives of oxolinic acid.** Znamenskij, V.V. (Institut Biofiziki, Moscow (USSR)); Kotel'nikova, N.V.; Leonova, T.S.; Yashunskij, V.G. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. RADIOPROTECTIVE SUBSTANCES/keto acids; AROMATICS; GAMMA RADIATION; INTRAPERITONEAL INJECTION; MICE; RADIATION DOSES

15423 (INIS-SU–210, pp. 710-711) **Protection and recovery of bone marrow in fractionated irradiation of animals in air and acute hypoxia.** Zubenkova, Eh.S. (Akademiya Meditsinskikh Nauk SSSR, Moscow (USSR). Onkologicheskij Nauchnyj Tsentr); Zajtsev, A.V.; Vajnson, A.A. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ANOXIA/response modifying factors; BONE MARROW/biological repair; BONE MARROW/radiation protection; ANOXIA; BLOOD FORMATION; FRACTIONATED IRRADIATION; LETHAL RADIATION DOSE; MICE; RADIATION SYNDROME; SPLEEN COLONY FORMATION; SURVIVAL CURVES

15424 (INIS-SU–210, pp. 711-712) **Prophylaxis of radiation injuries of thyroid by means of new selective radiation substance.** Ivanov, E.V. (Nauchno-Issledovatel'skij Inst. Radiatsionnoj Gigieny, Leningrad (USSR)); Artamonova, E.A.; Ponomareva, T.V. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. ORGANIC NITROGEN COMPOUNDS/radioprotective substances; RADIATION INJURIES/organic nitrogen compounds; THYROID/radiation injuries; HETEROCYCLIC COMPOUNDS;

IODINE 131; LOCAL IRRADIATION; RADIATION DOSES; RADIOIMMUNOASSAY; RADIOSENSITIVITY; RATS; THYROID; THYROID HORMONES; X RADIATION

15425 (INIS-SU–210, pp. 712-713) **Diethon is an effective agent of protection and treatment of skin in radiation effects.** Ivanov, E.V. (Nauchno-Issledovatel'skij Inst. Radiatsionnoj Gigieny, Leningrad (USSR)); Ponomareva, T.V.; Merkushev, G.N.; Dubur, G.Ya.; Bisenieks, Eh.A.; Maksimova, T.A.; Dauvorte, A.Zh. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. EPIDERMIS/radiation injuries; PYRIDINES/ointments; PYRIDINES/radioprotective substances; ANIMALS; BETA PARTICLES; EPIDERMIS; PATIENTS; PYRIDINES; OINTMENTS; RADIATION DOSES; RADIATION PROTECTION; SOFT X RADIATION; THERAPY

15426 (INIS-SU–231, pp. 135-138) **Method of measuring absorbed doses and prediction of delayed effect of skin, accidental irradiation.** Osanov, L.P.; Panova, V.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Methods of estimation and prediction of the degree of skin radiation injury as a results of accidental or planned single irradiation based on determination of quantitative relations between the absorbed dose depth distribution and the number of clonogenic basal cells, survived in epiderm and its derivatives after irradiation, are described. The given method of determination of ionizing radiation effect on skin permits to assess quantitatively the radiological effect - decrease of basal cells - using the results of absorbrd dose measurements. This permits to predict kinetics and state of acute radiation skin injury, thus settling the problem of medical care to personnel, to optimize maintenance and decontamination measures, to present foundation for radiotherapy.

15427 (LA–11997-MS) **Mortality among workers at the Mound Facility: A preliminary report.** Reyes, M.; Wilkinson, G.S.; Tietjen, G.L.; Wiggs, L.D.; Galke, W.A. Los Alamos National Lab., NM (USA). Apr 1991. 26p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91010482. Source: OSTI; NTIS; INIS; GPO Dep.

Mortality among 4,697 white males who were employed at the Mound Facility between 1943 and 1979 was compared with expected mortality based on US white male death rates. Standardized mortality ratios (SMRs) of 96 were observed for both all causes and all cancers. SMRs for digestive cancers and unintentional injuries were significantly less than 100. No SMR was significantly greater than 100 for these workers. A significantly elevated lung cancer SMR was observed for the subcohort of workers employed from 1943–1959, a period during which polonium-210 was processed at the plant. To determine the potential impact of wartime selection factors, this time period was further divided into two periods, 1943–1945 and 1946–1959. In the 1943–1945 period, the SMR for lung cancer was 204 (90% CI = 140, 290), while in the later period the lung cancer SMR was 105 (90% CI = 77, 140). Similar results were observed for all causes, all cancers, cancers of the rectum, nonmalignant respiratory diseases, and all injuries for which the SMRs were elevated during the wartime period but were not elevated after the war. Additional analyses considering workers hired in the period 1960–1979, during which plutonium-238 was processed at the facility, yielded little information. Generally, a strong healthy worker effect was observed and was attributed to the limited follow-up time and small numbers of deaths among this subcohort. 22 refs., 9 tabs.

15428 (LMF–129) **Inhalation Toxicology Research Institute annual report, October 1, 1989–September 30, 1990.** Thomassen, D.G.; Shyr, L.J.; Bechtold, W.E.; Bradley, P.L. (eds.). Lovelace Biomedical and Environmental Research Inst., Albuquerque, NM (USA). Inhalation Toxicology Research Inst. Dec 1990. 350p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76EV01013. Order Number DE91009419. Source: OSTI; NTIS; INIS; GPO Dep.

The mission of the Inhalation Toxicology Research Institute (ITRI) is to conduct basic and applied research concerning the human health impacts of inhaling airborne materials in the home, workplace and general environment. ITRI research programs have a strong basic science orientation with emphasis on the nature and behavior of airborne materials, the fundamental biology of the respiratory tract, the fate of inhaled materials and the mechanisms by which they cause disease, and the means by which data produced in the laboratory can be used to estimate risks to human health. Disorders of the respiratory tract continue to be a major health concern, and inhaled toxicants are thought to contribute substantially to respiratory morbidity. The papers in this report are organized along topical times, rather than by research programs, so that research within specific disciplines is more readily identified. The papers include summaries of research funded by DOE and non-DOE sources, to represent the full scope of ITRI activities. 123 figs., 80 tabs. (MHB)

15429 (PNL-SA–18907) **Accounting for bias and uncertainty resulting from dose measurement errors and other factors.** Gilbert, E.S. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. (CONF-9103140–2: Workshop on the future of human radiation research, Schloss-Elmau (Germany, F.R.), 4-8 Mar 1991). Order Number DE91010028. Source: OSTI; NTIS; INIS; GPO Dep.

It is the aim of this paper to provide a general appreciation of the issues and problems involved in addressing dose measurement error in making inferences about the dose-response function, and to suggest approaches that might be taken in future analyses of data from radio-epidemiologic studies. The paper is not intended to provide a thoroughly rigorous statistical treatment of the subject, and some assumptions may not be explicitly stated. This paper begins with a general discussion of measurement error, followed by discussion of approaches for handling both random and systematic error. However, dose measurement error is only one of many sources of uncertainty that have not usually been fully accounted for in epidemiologic analyses. At the end of the paper, brief consideration is given to the general problem of quantifying uncertainties from several sources. 15 refs., 1 tab.

15430 (PNL-SA–18927) **Experimental studies on lung carcinogenesis and their relationship to future research on radiation-induced lung cancer in humans.** Cross, F.T. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. (CONF-9103140–1: Workshop on the future of human radiation research, Schloss-Elmau (Germany, F.R.), 4-8 Mar 1991). Order Number DE91009145. Source: OSTI; NTIS; INIS; GPO Dep.

The usefulness of experimental systems for studying human lung carcinogenesis lies in the ease of studying components of a total problem. As an example, the main thrust of attack on possible synergistic interactions between radiation, cigarette smoke, and other irritants must be by means of research on animals. Because animals can be serially sacrificed, a systematic search can be made for progressive lung changes, thereby improving our understanding of carcinogenesis. The mechanisms of radiation-induced carcinogenesis have not yet been delineated, but modern concepts of molecular and cellular biology and of radiation dosimetry are being increasingly applied to both in vivo and in vitro exposure to determine the mechanisms of radiation-induced carcinogenesis, to elucidate human data, and to aid in extrapolating experimental animal data to human exposures. In addition, biologically based mathematical models of carcinogenesis are being developed to describe the nature of the events leading to malignancy; they are also an essential part of a rational approach to quantitative cancer risk assessment. This paper summarizes recent experimental and

modeling data on radon-induced lung cancer and includes the confounding effects of cigarette-smoke exposures. The applicability of these data to understanding human exposures is emphasized, and areas of future research on human radiation-induced carcinogenesis are discussed. 7 refs., 2 figs., 3 tabs.

15431 (RERF-TR-6-90) **Radiosensitivity of skin fibroblasts from atomic bomb survivors with and without breast cancer.** Ban, Sadayuki (and others); Setlow, R.B.; Bender, M.A. Radiation Effects Research Foundation, Hiroshima (Japan). Nov 1990. 22p. Order Number DE91768051. Source: OSTI; NTIS (US Sales Only); INIS.

Fibroblasts were established in vitro from skin biopsies obtained from 55 women and one man with or without breast cancer and with or without exposure to radiation from the atomic bomb explosion in Hiroshima. The radiosensitivity of these cells was evaluated by clonogenic assays after exposure to X rays or to fission neutrons from a ^{252}Cf source. Data were fitted to a multitarget model, $S/S_0 = A[1-(1-e^{kD})^N]$, for both X-ray and neutron dose-survival curves. A single-hit model, $S/S_0 = Ae^{kD}$, fits the neutron dose-survival responses as well. There was no difference in the means or variances of radiosensitivity between exposed and nonexposed groups, or between patients with or without breast cancer. Hence, although the sample is not large, it provides no support for the hypothesis that A-bomb radiation preferentially induces breast cancer in women whose cells in vitro are sensitive to cell killing by radiation. (author).

15432 (SKB-TR-90-26) **The effect from the number of cells, pH and lanthanide concentration on the sorption of promethium on the gramnegative bacterium (Shewanella putrefaciens).** Pedersen, K. (Goeteborg Univ. (Sweden). Dept. of General and Marine Microbiology); Albinsson, Y. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Jun 1990. 24p. Order Number DE91625741. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of this work was to investigate the sorption of the lanthanide promethium on bacteria and the distribution ratio, K_d, of the lanthanide between bacteria and water at different cell numbers, pH and lanthanide concentrations. There was a negative linear relationship between the number of cells and the amount of the Pm sorbed, and also between the number of cells and the K_d. The sorption decreased from a stable level at 90% as pH was raised above 7. There was a linear quantitative relation between the Pm concentration and the amount of Pm sorbed on the cells while the relation to K_d was relatively constant. The results indicate the sorption of trivalent actinides and lanthanides on bacteria to be a reversible surface adsorption. (orig.).

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Refer also to citation(s) 14966, 15276, 15305, 15306, 15308, 15310, 15316, 15317, 15318, 15319, 15320, 15321, 15324, 15428

15433 (CONF-910659-4) **Ozone, acidic precipitation, and soil Mg effects on growth and nutrition of loblolly pine seedlings after three growing seasons.** Edwards, G.S. (Tennessee Valley Authority, Norris, TN (USA)); Kelly, J.M.; Edwards, N.T. Oak Ridge National Lab., TN (USA). [1991]. 15p. Sponsored by USDOE, Washington, DC (USA); Electric Power Research Inst., Palo Alto, CA (USA); Tennessee Valley Authority, Knoxville, TN (USA). DOE Contract AC05-84OR21400. From 84. annual meeting and exhibition of the Air and Waste Management Association (AWMA); Vancouver (Canada); 16-21 Jun 1991. Order Number DE91009556. Source: OSTI; NTIS; GPO Dep.

A study was initiated in 1987 to evaluate the impact of O_3, acidic precipitation, and soil Mg on the growth and nutrition of loblolly pine (Pinus taeda L.) seedlings. Thirty-six open top chambers equipped with a rainfall exclusion/addition system were utilized to administer three levels of O_3 (subambient, ambient, and twice ambient) and two rainfall pH levels (3.8 and 5.2) to seedlings growing in 24-L plastic pots containing soil having either 35 or 15 mg kg^{-1} of exchangeable Mg. Each chamber contained 36 pots, and each treatment combination was replicated six times for a total of 1296 individual pots. After three seasons, biomass of all seedling components was progressively reduced with increasing O_3 concentrations. Foliar nutrient leaching was not accelerated by increasing the acidity of precipitation from pH 5.2 to 3.8, and O_3 did not act to exacerbate foliar leaching. Also, foliar nutrient concentrations were not significantly affected by precipitation pH or O_3 treatments, and there was not accelerated soil leaching associated with chronic acidic precipitation. Differences in soil Mg treatments were reflected in soil solution and seedling Mg contents, but the 15 mg kg^{-1} soil Mg treatment was not sufficient to induce Mg deficiency in the seedlings. 24 refs., 6 figs., 2 tabs.

15434 (CONF-910659-8) **Indirect pathways as the primary source of human exposure to emissions from a Minnesota Municipal Waste Combustor.** Neely, B.L. (Oak Ridge National Lab., TN (USA)); Yambert, M.W.; Travis, C.C.; Hester, S.T.; Cleverly, D. Oak Ridge National Lab., TN (USA). [1991]. 11p. Sponsored by USDOE, Washington, DC (USA); Environmental Protection Agency, Washington, DC (USA). DOE Contract AC05-84OR21400. From 84. annual meeting and exhibition of the Air and Waste Management Association (AWMA); Vancouver (Canada); 16-21 Jun 1991. Order Number DE91009934. Source: OSTI; NTIS; GPO Dep.

Increasing problems of land disposal have forced many communities to actively consider incineration as a disposal alternative. With the growth of incineration arises the fundamental issue of the environmental impact of pollutants in combustor emissions. Municipal Waste Combustors (MWC) are known to release both metals and organics into the environment. In the past, most analyses of human health risk associated with atmospheric emissions from combustion sources have focused only on exposures resulting from direct inhalation. Recent studies, however, have linked elevated levels of pollutants in soils, lake sediments, and cow's milk to atmospheric transport and deposition of pollutants from combustion sources. These studies indicate that deposition of atmospherically emitted pollutants could result in indirect pathways of exposure for humans. Indirect exposure pathways include ingestion of contaminated drinking water, crops, fish, or even soil, although food ingestion is the primary route of indirect exposure. The purpose of the present study is to assess the extent to which indirect exposure pathways, particularly the terrestrial food chain, pose risks to human health. This will be accomplished by applying the U.S. EPA Methodology for Assessing Health Risks Associated with Indirect Exposure to Combustor Emissions to a MWC in Minnesota. This study will focus on the following toxic organic compounds and heavy metals: benzo(a)pyrene, dioxin, polychlorinated biphenyls, hexachlorobenzene, arsenic, cadmium, chromium, lead, mercury, and nickel. 33 refs., 8 tabs.

15435 (DOE/ER/60469-4) **Metabolism and toxicity of trace metals in the marine mussel, Mytilus edulis: Final report, July 1, 1986-January 30, 1990.** Roesijadi, G. Maryland Univ., Solomons, MD (USA). Chesapeake Biological Lab. [1990]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-86ER60469. Order Number DE91009633. Source: OSTI; NTIS; GPO Dep.

Since trace metals such as mercury, cadmium, copper, and zinc can be released to the marine environment as a result of the operation of energy technologies, their potential effects on marine organisms need to be understood. Marine organisms have the capability to respond to metal exposure through acclimatization or adaptation to altered conditions. Mechanisms which may be involved in conferring such capabilities have also been identified. This research project investigated one of these mechanisms, the low molecular weight, metal-building protein MT, in relation to metal toxicity and acclimatization/adaptation. Specific topics included purification and characterization of molluscan MTs; examination of the kinetics of induction of these proteins in response to the above metals; the cellular disposition of metals in relation to induction; and metal-toxicity in relation to induction of metal-binding proteins. Studies were conducted on the bay mussel Mytilus edulis and the American oyster Crassostrea virginica. These efforts were planned to contribute to a better understanding of MTs and their relationship to toxic and adaptive responses in commercially- and ecologically-important marine animals. 23 refs.

15436 (ETDE-mf-1764476) **Advisory Research Committee on Forest Damage/Air Pollution. Third report.** Forschungsbeirat

Waldschaeden/Luftverunreinigungen der Bundesregierung und der Laender (Germany, F.R.). Nov 1989 607p. (In German). Order Number DE91764476. Source: OSTI; NTIS (US Sales Only).

In this report (Part B) the advisory committee gives a survey and a summary of today's state of knowledge and information. The following statements are given: There has not been a major recovery of the forests over the last three years. The degree of damage of deciduous trees has increased, damage of conifers has slightly decreased after the peak in 1985/86. The major outer symptoms of the 'new forest damage' are known from the past. What is new is the wide geographic expansion and their higher representation in a particular region and the fact that several types of trees are affected at once, within a few years. New forest damages are caused by a complex of abiotic and biotic factors. Anthropogeneous air-pollution from industrial plants, power stations, traffic, households and agriculture play a major role. Needle yellowing of spruces in the higher part of low mountain ranges are sufficiently explained by soil acidification caused by air pollutant deposition. Direct effects of air pollution act as additional stress factors. Other types of damage can be caused by direct impact of anthropogeneous air pollution on the tree's organs above ground, in this case the acidification of the soil could play the role of a predisposing stressor. The advisory council sees the drastic reduction of the emission of pollutants on a national and international level as a major precondition for the vitality of the forests. (orig./MG).

15437 (LA-UR-91-782) **Preliminary observations of lung injury produced by instillation of HF in acidic and neutral buffer.** Brainard, J.R.; Kinkead, S.A.; Kober, E.M.; Sebring, R.J.; Stavert, D.M.; Lehnert, B.E. Los Alamos National Lab., NM (USA). [1990]. 7p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9011164-2: 1990 scientific conference on chemical defense research, Aberdeen Proving Ground, MD (USA), 14-18 Nov 1990). Order Number DE91009941. Source: OSTI; NTIS; GPO Dep.

Perfluoroisobutylene (PFIB) is an extremely toxic organofluoride that can be produced during pyrolysis of tetrafluoroethylene polymers, including Teflon®. Inhalation of PFIB at very low concentrations causes acute lung injury, the hallmark of which is pulmonary edema. Several lines of evidence have suggested that hydrolysis of PFIB and resulting production of hydrofluoric acid may be responsible for pulmonary damage. In order to investigate the potential involvement of hydrofluoric acid in producing lung injury and its relationship to the mechanism of fluorocarbon toxicity, we have compared the pulmonary injury produced by PFIB, by dissociated (H^+ and F^-), and by undissociated (HF) hydrofluoric acid in the deep lung. By delivering hydrofluoric acid by intratracheal instillation in neutral buffer, we demonstrate that F^- produces no significant pulmonary injury as assessed by increased in lung weight and ultrastructural changes. Similarly, instillation of acid buffer alone demonstrated that H^+ did not produce detectable lung injury. Instillation of HF produced changes in lung weight and ultrastructure similar to those observed in PFIB-treated rats. However, the ultrastructural studies show that in contrast to inhalation of PFIB, which produces both endothelial and epithelial cell damage, instillation of HF appears to exert its injurious effects only upon epithelial cells. 9 refs., 1 fig.

15438 (PNL-SA-18965) **Rational redesign of the biodegradative enzyme cytochrome P450 cam: A progress report on engineering specificity for halogenated hydrocarbon substrates.** Ornstein, R.; Paulsen, M.; Bass, M.; Arnold, G. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. (CONF-9103114-1: In situ and on-site bioreclamation: an international symposium, San Diego, CA (USA), 19-21 Mar 1991). Order Number DE91010010. Source: OSTI; NTIS; INIS; GPO Dep.

Cytochromes P450, a superfamily of monooxygenase enzymes present in all kingdoms of living organisms, are very versatile with respect to substrate range and catalytic functionality. Many recalcitrant halogenated hydrocarbons, on DOE sites and throughout the nation, result in serious environmental impact. Cytochromes P450 have been shown to be catalytically capable of, at least partial, dehalogenation of some such compounds. Clearly, however, their active site stereochemistry and related functional components are not well suited for this role because the rates of dehalogenation are generally rather modest. The evolution of modified active site and access channel structures may proceed very slowly if multiple genetic changes are simultaneously required for enzyme adaptation. Since each mutational event is by itself a rare event, a basic premise of our research is that designing multiple changes into an enzyme may be more timely than waiting for them to occur biologically either via natural selection or under laboratory-controlled conditions. Starting with available high-resolution x-ray crystal structures, molecular modeling and molecular dynamics simulations have been used to probe the basic structure/function principles and conformational fluctuations of the biodegradative enzyme, cytochrome P450cam (camphor hydroxylase from Pseudomonas putida) and active site mutants, to provide the fundamental understanding necessary for rational engineering of the enzyme for modified substrate specificity. In the present paper, we review our progress to data, in the area of molecular dynamics simulations and active site redesign of P450cam. 36 refs., 2 figs.

15439 (RFP-4348) **Qualitative risk assessment as a remediation management tool.** Knutson, D.E. EG and G Rocky Flats, Inc., Golden, CO (USA). 14 Mar 1991. 180p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC34-90DP62349. Order Number DE91010415. Source: OSTI; NTIS; INIS; GPO Dep.

The technique used to complete this thesis utilizes existing NRC and EPA guidance on health-based risk to qualitatively prioritize preliminary assessments and provide a tool for the direction and management of remediation activities. This method is intended as a decision making tool to aid in prioritizing the remediation effort and manage the remedial investigation and feasibility study (RI/FS) process. It is not a replacement for the RI/FS. The methodology for qualitative risk assessment utilizes data gathered in preliminary assessments and calculates the health-based hazards and consequences from contaminants found at each individual location. The health-based qualitative risk indicated that #6 fuel oil, carbon tetrachloride, depleted uranium, and enriched uranium were the contaminants of major concern, in that order. Plutonium ranked approximately sixth in the contaminant of concern priority. 38 refs., 1 fig., 9 tabs.

15440 (UCRL-LR-104684) **Health hazard evaluation of the postcuring phase of graphite composite operations at the Lawrence Livermore National Laboratory, Livermore, California.** Kwan, Joseph Kai-cho. Lawrence Livermore National Lab., CA (USA). May 1990. 198p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91010119. Source: OSTI; NTIS; GPO Dep.

Thesis. Submitted to University of California, Los Angeles.

In this project, particulates generated from various conventional and laser machining processes involving graphite composite materials were characterized. Airborne particulate were examined with both phase-contrast light microscopy and scanning electron microscopy to determine the physical size and morphology of the particles and to search for respirable-size graphite fibers. Chemical species generated from laser machining were isolated, identified, and quantified by gas chromatograph/mass spectrometry. Particulates collected on filters from air sampling of the machining process were chemically extracted and analyzed to determine if significant adsorption of the volatile species had occurred onto these particles. Portions of the extract were also evaluated for mutagenicity using the Ames test. The majority of the chemicals identified were polynuclear aromatic hydrocarbons. Toxicological review of these chemicals revealed toxicities ranging from irritation to carcinogenicity. Exposure limits have been established for only a few of the identified chemicals. At the source of generation, the concentrations of the carcinogens phenanthrene and pyrene were in excess of the allowable limits. Engineering control measures for various postcuring operations were discussed. Several policy issues, including exposure limit for graphite fibers and composite dust, regulation of laser machining operations, and treatment of graphite composite waste materials were addressed. 17 refs., 73 figs., 25 tabs.

5604 Other Environmental Pollutant Effects

15441 (LA-UR–91-905) **Gruneisen-stress induced ablation of biological tissue.** Dingus, R.S.; Scammon, R.J. Los Alamos National Lab., NM (USA). [1991]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910123–19: OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium, Los Angeles, CA (USA), 20-25 Jan 1991). Order Number DE91009957. Source: OSTI; NTIS; GPO Dep.

The objective of biomedical applications of lasers is frequently to remove tissue in a controlled manner. However, for ablation induced by thermal- or photo-decomposition, damage to surrounding tissue may be excessive in some instances. Tissue can also be ablated by a hydrodynamic process referred to as front surface spallation, in which a thin layer next to a free surface is heated to levels, below vaporization but, so rapidly that it cannot undergo thermal expansion during laser heating. This generates a stress pulse, which propagates away from the heated region, with an initial amplitude that can be calculated using the Grueneisen coefficient. As the pulse reflects from the free surface, a tensile tail can develop of sufficient amplitude, exceeding the material strength, that a layer will be spalled off, taking much of the laser-deposited energy with it. Because tissue is generally a low strength material, this process has the potential of producing controlled ablation with reduced damage to the remaining tissue. However, to achieve these conditions, the laser pulse length, absorption depth and fluence must be properly tailored. This paper presents hydrodynamic calculations and analytical modeling relating to both stress- and thermal-induced ablation as a function of laser and tissue properties to illustrate the potential benefits of stress induced ablation. Also, guidance is given for tailoring the exposure parameters to enhance front surface spallation. 8 refs., 6 figs.

15442 (ORNL/TM–11479) **Implementation plan for Air Force Environmental Noise Assessment Center.** Braid, R.B.; Reed, J.H. Oak Ridge National Lab., TN (USA). Feb 1991. 71p. Sponsored by Department of Defense, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010446. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This report details an implementation plan for establishing the Air Force Environmental Noise Assessment Center (AFENAC or the Center) to serve as the Air Force's single center for environmental noise assessment. AFENAC would be staffed by the Air Force's experts in applied environmental noise assessment and community planning and would be responsible for implementing various technologies throughout the Air Force to calculate expected noise levels from different aircraft operations. More specific AFENAC responsibilities are discussed in Sect. 2. AFENAC would be important in facilitating the Air Force's flying mission, in view of growing public concern over noise-related issues around air bases and beneath low altitude and supersonic airspaces as well as encroaching land uses around air bases. This implementation plan recommends how AFENAC could be established and operated to achieve its purpose. The plan reflects considerable interaction between the authors and a number of Air Force organizations including the program office, HQ AFESC/DEMP, and the associated staff of the AICUZ program; air staff personnel in HQ USAF/LEEV, HQ USAF/LEED, and HQ USAF/XOOSA; NSBIT; AAMRL/BBE; HQ AFSC/XTH; HQ AFLC/DEPR; and various personnel on the environmental community planning, and operations staffs at the Tactical Air Command, Air Force Logistics Command, Air National Guard, and Air Force Reserves. This implementation plan consists of four major sections. Section 2 sets forth the responsibilities of AFENAC. Section 3 discusses the organization, staffing, and funding of AFENAC. The noise assessment technologies and associated computer hardware that should be transferred to Air Force users through the auspices of AFENAC are detailed in Sect. 4, and Sect. 5 establishes a schedule and procedures for accomplishing these objectives. 3 figs., 7 tabs.

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Refer also to citation(s) 14694

15443 (LA-UR–91-556) **On the measurement of wind speeds in tornadoes with a portable CW/FM-CW Doppler radar.** Bluestein, H.B. (Oklahoma Univ., Norman, OK (USA). School of Meteorology); Unruh, W.P. Los Alamos National Lab., NM (USA). [1991]. 15p. Sponsored by USDOE, Washington, DC (USA); National Science Foundation, Washington, DC (USA). DOE Contract W-7405-ENG-36. Grant ATM-8902594. (CONF-9104193–1: 3. tornado symposium, Norman, OK (USA), 2-5 Apr 1991). Order Number DE91008589. Source: OSTI; NTIS; GPO Dep.

Both the formation mechanism and structure of tornadoes are not yet well understood. The Doppler radar is probably the best remote-sensing instrument at present for determining the wind field in tornadoes. Although much has been learned about the nonsupercell tornado from relatively close range using Doppler radars at fixed sites, close-range measurements in supercell tornadoes are relatively few. Doppler radar can increase significantly the number of high-resolution, sub-cloud base measurements of both the tornado vortex and its parent vortex in supercells, with simultaneous visual documentation. The design details and operation of the CW/FM-CW Doppler radar developed at the Los Alamos National Laboratory and used by storm-intercept teams at the Univ. of Oklahoma are described elsewhere. The radar transmits 1 W at 3 cm, and can be switched back and forth between CW and FM-CW modes. In the FM-CW mode the sweep repetition frequency is 15.575 kHz and the sweep width 1.9 MHz; the corresponding maximum unambiguous range and velocity, and range resolution are 5 km, $\pm$ 115 m s^{-1}, and 78 m respectively. The bistatic antennas, which have half-power beamwidths of 5°, are easily pointed wit the aid of a boresighted VCR. FM-CW Data are recorded on the VCR, while voice documentation is recorded on the audio tape; video is recorded on another VCR. The radar and antennas are easily mounted on a tripod, and can be set up by three people in a minute or two. The purpose of this paper is to describe the signal processing techniques used to determine the Doppler spectrum in the FM-CW mode and a method of its interpretation in real time, and to present data gathered in a tornadic storm in 1990. 15 refs., 7 figs.

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Refer also to citation(s) 14270, 14279, 14591, 15216, 15300, 15323

15444 (JAB–10733-TM3) **Overview of seismic signal conversion and processing operations.** Lum, P.K. Blume (John A.) and Associates Research Div., San Francisco, CA (USA). Mar 1991. 56p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC08-89NV10733. Order Number DE91009513. Source: OSTI; NTIS; GPO Dep.

URS/John A. Blume & Associates, Engineers (URS/Blume) is assigned by the US Department of Energy the responsibility of providing support to the safety program of the Nevada Operations Office (DOE-NV) with respect to documentation of seismic motion and evaluation of the effects of ground motion on structures and facilities. In this capacity, URS/Blume conducts a seismic documentation program with the primary objective of measuring, for analysis and evaluation, the ground structural response motion resulting from underground nuclear explosions (here called events), principally at the Nevada Test Site (NTS). This report gives a brief overview of the current operation and other related functions for processing seismic signals such as: basic information on the seismic recording systems and stations; a brief description of hardware, hardware configurations, and software; data formats; processing techniques used to convert seismic signals to computer compatible format; signal reduction and processing; and data controls. 12 refs., 7 figs., 3 tabs.

15445 (LBL–29817) **IRIS-SEIS users manual and installation guide: Version 1.3.0.** Okaya, D.; Karageorgi, E.; Daley, T.M. Lawrence Berkeley Lab., CA (USA). Nov 1990. 173p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010230. Source: OSTI; NTIS; GPO Dep.

The IRIS-SEIS seismological processing package is a software extension to Sierra Geophysics' SIERRASEIS seismic data processing package. By using IRIS-SEIS, one can apply algorithms which are not provided within the original SIERRASEIS package. In

addition, IRIS-SEIS provides an environment so that users may add locally developed algorithms into the IRIS-SEIS/SIERRASEIS package. Some knowledge of FORTRAN and UNIX is required to add routines into IRIS-SEIS. IRIS-SEIS will not run as a stand-along software package but is written to be integrated with SIERRASEIS. The user must have a valid SIERRASEIS license in order to properly install and run IRIS-SEIS. IRIS-SEIS as presented here is supported on SUN/UNIX-based systems; references to operating system commands or to installation command files are based on the UNIX operating system. In addition to providing access to all original processing routines, IRIS-SEIS provides several capabilities which are not available to in SIERRASEIS. Most important, IRIS-SEIS separates SIERRASEIS routines from IRIS routines so that the IRIS- added routines do not corrupt the SIERRASEIS routines or infrastructure. Functionality available within IRIS-SEIS are user-definable headers, import of external data, utility processors to fix trace headers, and additional processing algorithms. This reference manual provides information which is needed to optimally use IRIS-SEIS. The first of three sections discusses the SIERRASEIS environment which provides a reference into which IRIS-SEIS and "LOCAL-SEIS" resides. The second section provides information on IRIS-SEIS (e.g., capabilities, installation procedures, how to run a job, etc.). The third section provides similar information on LOCAL-SEIS. Within the appendices, user documentation on each IRIS-SEIS processor is given. An appendix describes a set of C-language I/O utility routines for FORTRAN code; several IRIS-SEIS processors use this library.

15446 (LBL–29817-Rev.1) **IRIS-SEIS users manual and installation guide: Version 1.3.0: Revision 1.** Okaya, D.; Karageorgi, E.; Daley, T.M. Lawrence Berkeley Lab., CA (USA). Jan 1991. 183p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010235. Source: OSTI; NTIS; GPO Dep.

The IRIS-SEIS seismological processing package is a software extension to Sierra Geophysics' SIERRASEIS seismic data processing package. By using IRIS-SEIS, one can apply algorithms which are not provided within the original SIERRASEIS package. In addition, IRIS-SEIS provides an environment so that users may add locally developed algorithms into the IRIS-SEIS/SIERRASEIS package. Some knowledge of FORTRAN and UNIX is required to add routines into IRIS-SEIS. This reference manual provides information which is needed to optimally use IRIS-SEIS. The first of three sections discusses the SIERRASEIS environment which provides a reference into which IRIS-SEIS and "LOCAL-SEIS" resides. The second section provides information on IRIS-SEIS. The third section provides similar information on LOCAL-SEIS. Within the appendices, user documentation on each IRIS-SEIS processor is given. An appendix describes a set of C-language I/O utility routines for FORTRAN code; several IRIS-SEIS processors use this library.

15447 (SKB-TR–90-30) **The earthquakes of the Baltic shield.** Slunga, R. (Swedish National Defence Research Inst., Stockholm (Sweden)). Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Jun 1990. 21p. Order Number DE91624447. Source: OSTI; NTIS (US Sales Only); INIS.

More than 200 earthquakes in the Baltic Shield area in the size range ML 0.6-4.5 have been studied by dense regional seismic networks. The analysis includes focal depths, dynamic source parameters, and fault plane solutions. In southern Sweden a long part of the Protogene zone marks a change in the seismic activity. The focal depths indicate three crustal layers: Upper crust (0-18 km in southern Sweden, 0-13 km in northern Sweden), middle crust down to 35 km, and the quiet lower crust. The fault plane solutions show that strike-slip is dominating. Along the Tornquist line significant normal faulting occurs. The stresses released by the earthquakes show a remarkable consistency with a regional principle compression N60W. This indicates that plate-tectonic processes are more important than the land uplift. The spatial distribution is consistent with a model where the earthquakes are breakdowns of asperities on normally stably sliding faults. The aseismic sliding is estimated to be 2000 times more extensive than the seismic sliding. Southern Sweden is estimated to deform horizontally at a rate of 1 mm/year or more. (orig.).

15448 (STRIPA-TR–90-08) **Site characterization and validation - hydrochemical investigations. Stage 3.** Laaksoharju, M. (Royal Inst. of Tech., Stockholm (Sweden)). Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Feb 1990. 14p. Order Number DE91624448. Source: OSTI; NTIS (US Sales Only); INIS.

The objective for the Stage 3 hydrochemical investigations was to classify groundwater and to determine the different flow paths within the investigated SCV-site by using water analyses from the C and D boreholes. The water was divided into three classes shallow (A), mixed (B) and deep groundwater (C) based on Cl and HCO_3 concentration. The local geohydrological situation in the SCV-site can be divided into a disturbed situation and an undisturbed situation. Opening of the boreholes and smapling causes a disturbance of hydrochemical conditions. Three water types were found in the important water conductors, the GB and the GH zones. Shallow water (A-type) is flowing downwards while deep groundwater (C-type) is flowing upwards driven by the pumping of the mine. Where the two water types meet a zone of approximately 30 m thickness with mixed (B-type) water is formed. The flow situation is revealed by the geohydrological measurements. At undisturbed conditions shallow water (A-type) is flowing down in the investigated zones. The B and C water types are then found at a deeper level than during disturbed conditions. A regional model can be constructed based on the described chemical and geohydrological investigations. Shallow water from the top and deep groundwater from below are drawn towards the mine by the pumping. Where these waters meet mixed water is formed. (orig./HP).

15449 (STRIPA-TR–90-09) **Site characterization and validation - stress field in the SCV block and around the validation drift. Stage 3.** McKinnon, S. (JAA AB, Luleaa (Sweden)); Carr, P. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Apr 1990. 91p. Order Number DE91624449. Source: OSTI; NTIS (US Sales Only); INIS.

The results of previous stress measurement and stress modelling programmes carried out in the vicinity of the SCV block have been reviewed. Collectively, the results show that the stress field is influenced by the presence of the old mine excavations, and the measurements can be divided into near-field and far-field locations. The near-field measurements denote the extent and magnitude of the mining induced stresses while the far-field measurements reflect virgin conditions. Because of large scatter in the previous data, additional stress measurements were carried out using the CSIRO hollow inclusion cell. Combining all measurements, an estimate of the virgin stress tensor was made. Three-dimensional stress modelling was carried out using the program BEFE to determine the state of stress in the SCV block, and around the validation drift. This modelling showed that most of the SCV block is in a virgin stress field. Stresses acting on the fracture zones in the SCV block will be due only to the virgin stress field and induced stresses from the validation drift. (orig.).

15450 (STRIPA-TR–90-16) **The Stripa project. Annual report 1989.** Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). May 1990. 132p. Order Number DE91624450. Source: OSTI; NTIS (US Sales Only); INIS.

Participating countries in the Phase 3 of the Stripa project are Canada, Finland, Japan, Sweden, Switzerland, United Kingdom and the United States. The research activities in this third phase of the Stripa project are carried out under two headings: Fracture flow and nuclide transport; and groundwater flow path sealing. Under the heading 'Fracture flow and nuclide transport' the main objectives are: to predict groundwater flow and nuclide transport in a specific unexplored volume of the Stripa granite and make a comparison with data from field measurements. The comparison is made by means of an integrated approach with existing site characterization tools and methods, particularly those developed under Phases 1 and 2, this programme is referred to as the 'Site characterization and validation' programme; to continue the development of site assessment methods and strategies and, where found appropriate, apply them in later stages of the integrated site characterization exercise outlined above. This programme is referred to as 'Improvement of site assessment methods and concepts'. Under the heading 'Groundwater flow path sealing' the principal objectives

are: to identify, select and evaluate sealing substances which promise to possess longterm chemical and mechanical stability and to demonstrate in field tests, by use of suitable methods and techniques, the effectiveness of such substances for the long-term sealing of groundwater flow paths in the Stripa granite. The total programme is referred to as 'Sealing of fractured rock'. (orig./HP).

15451 (YJT–89-19) **Diffusivity and electrical resistivity measurements in rock matrix around fractures.** Kumpulainen, H. (Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Reaktorilab.); Uusheimo, K. Teollisuuden Voima Oy (Finland). Dec 1989. 54p. Order Number DE91624451. Source: OSTI; NTIS (US Sales Only); INIS.

Microfracturing of rock matrix around permeable fractures was studied experimentally from drill core samples around major fractures. The methods used were diffusion measurements using a ^{36}Cl-tracer and electrical resistivity measurements. Rock samples were from the Romuvaara investigation site, the granite specimen around a partially filled carbonate fracture (KR4/333 m) and gneiss specimen around a slickenside fracture (KR1/645 m). A consistent difference of one to two orders of magnitude in the levels of the methods with regard to the effective diffusion coefficients for Cl^--ion was found, the electrical resistivity measurement giving higher values. On the basis of the diffusion measurements the diffusion porosities could be calculated but these remained one to two orders of magnitude lower than that expected for granitic rocks using the water saturation method. A possible reason for these differences could have been the low, in some cases 0.004 M NaC1-concentration in the diffusion experiments vs. the 1 M NaCl-concentration used in the electrical resistivity measurements. Due to the small number of specimens and cross sectional areas of only 2 cm^2, rock inhomogeneity effects were significant making the interpretation of the results somewhat troublesome. Porosities on fracture surfaces seemed to be higher than in the deeper, more intact rock matrix.

64 PHYSICS I

Refer also to citation(s) 15981, 15982

15452 (IC–90/226) **Lectures on the basis of physics.** Cook, A. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 27p. Order Number DE91625181. Source: OSTI; NTIS (US Sales Only); INIS.

The paper contains the following three lectures given by Alan Cook at ICTP Trieste in August, 1990: "Metrology and the Structure of Physics", "Why does Mathematical Physics Work?" and "Probability, Chaos and the Environment. 9 refs.

15453 (INIS-SU–232) **Theoretical and applied physics: Scientific-technical collection.** Voprosy atomnoj nauki i tekhniki. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1988 43p. (In Russian). Order Number DE91003077. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers in this collection are indexed.

15454 (INIS-SU–233) **Theoretical and applied physics: Scientific-technical collection.** Voprosy atomnoj nauki i tekhniki. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989 38p. (In Russian). Order Number DE91003083. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers in this collection are indexed.

15455 (INIS-SU–234) **Simulation of physical processes: Scientific-technical collection.** Voprosy atomnoj nauki i tekhniki. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989 82p. (In Russian). Order Number DE91003090. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers in this collection are indexed.

15456 (INIS-SU–237) **Experimental and theoretical physics: Collection.** Kratkie soobshcheniya po fizike. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989 58p. (In Russian). Order Number DE91003081. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers in this collection are indexed.

15457 (INIS-SU–239) **Quantum radiophysics: Collection.** Kratkie soobshcheniya po fizike. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989. 44p. (In Russian). Order Number DE91003091. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers in this collection are indexed.

6401 Astrophysics and Cosmology

Refer also to citation(s) 15153, 15540, 15571, 15635, 15751

15458 (ANL/CP–72318) **Microbeam titanium isotopic analysis by resonance ionization mass spectrometry.** Spiegel, D.R. (Chicago Univ., IL (USA). Enrico Fermi Inst.); Davis, A.M.; Clayton, R.N.; Pellin, M.J.; Calaway, W.F.; Burnett, J.W.; Coon, S.R.; Young, C.E.; Gruen, D.M. Argonne National Lab., IL (USA). [1991]. 3p. Sponsored by USDOE, Washington, DC (USA); National Aeronautics and Space Administration, Washington, DC (USA). DOE Contract W-31109-ENG-38. Grant NAG 9-51;Grant NAG 9-111. (CONF-9103134–2: Lunar and planetary science conference, Houston, TX (USA), 18-22 Mar 1991). Order Number DE91010799. Source: OSTI; NTIS; INIS; GPO Dep.

The importance of isotopic anomalies in refractory inclusions in meteorites is well established. Measurements of the anomalies using conventional mass spectrometry are often rendered difficult, however, by isobarically interfering isotopes: for example, ^{48}Ti and ^{48}Ca. Resonance ionization mass spectrometry (RIMS) can substantially reduce isobaric interferences in a number of systems. We have employed RIMS for the in situ detection of Ti atoms sputtered from pure Ti metal and from several terrestrial oxides containing both Ti and Ca. Tunable lasers were employed to resonantly ionize neutral Ti atoms. We have chosen Ti specifically because of the importance of Ti isotopic anomalies in cosmochemistry.

15459 (DOE/ER/40423–06-P90) **Biaxial Bianchi type 9 quantum cosmology.** Jensen, L.G. (Washington Univ., Seattle, WA (USA). Dept. of Physics); Louko, J.; Ruback, P.J. Washington Univ., Seattle, WA (USA). Dept. of Physics. Apr 1990. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AS06-88ER40423. (CERN-TH–5618/90). Order Number DE91009610. Source: OSTI; NTIS; INIS; GPO Dep.

We investigate the quantum cosmology of spatially homogeneous models with compact spatial sections admitting a u(2) isometry algebra. The metric ansatz in these models is that of Bianchi type IX with two scale factors set to be equal. We apply the Hartle-Hawking no-boundary path integral prescription and find the semi-classical contributions to the wave function. Exact formulae are obtainable for certain contributions and otherwise the limits of large and small anisotropy (for the pure vacuum case) and large spatial volume or small anisotropy (for the case with a positive cosmological constant) are considered. For the pure vacuum case we find no semiclassical components which would correspond to Lorentzian universes. For the case with a cosmological constant the Hartle-Hawking boundary conditions formally constrain one of the parameters in the Lorentzian solutions to be purely imaginary. Possible interpretations of this imaginary parameter are discussed. 27 refs.

15460 (DOE/ER/40423–19) **A new mechanism for neutralizing the cosmological constant.** Duncan, M.J. (Minnesota Univ., Minneapolis, MN (USA). Dept. of Physics); Jensen, L.G. Washington Univ., Seattle, WA (USA). Dept. of Physics. [1991]. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AS06-88ER40423 ;AC02-83ER40105. (UMN-TH–908/90). Order Number DE91009790. Source: OSTI; NTIS; GPO Dep.

We propose a dynamical mechanism for neutralizing the cosmological constant in our universe. The analysis is wholly Lorentzian, unlike most other mechanisms which rely on the problematic Euclidean quantum gravity. Additionally, we do not have to assume any properties of a complete quantum gravity theory for our result. Quantum cosmology is an effective theory below the Planck scale,

and it suffices for the purpose of our demonstration. The vacuum energy from particle physics is many orders of magnitude to great to explain the measured smallness of the cosmological constant. Any generic field that allows us to shift the vacuum energy has the possibility of neutralizing it. However, such a field has an infinity of possible vacuum states, and we have to be in exactly the right one to achieve the cancellation. We show that when we third quantize a cosmology containing such a field in its particle physics sector we do have the possibility of selecting one vacuum over another. (The field we use for the sake of demonstration is a four-form.) The essential result of our paper is that the dominant vacuum state for the field is indeed the one that exactly cancels the particle physics vacuum energy. This means that a large universe, such as ours, has a vanishing cosmological constant. 25 refs.

15461 (FNAL/C–91/56-A) **Ultrahigh-energy particles from cosmic strings.** Bhattacharjee, P. (Chicago Univ., IL (USA). Astronomy and Astrophysics Center). Fermi National Accelerator Lab., Batavia, IL (USA). Feb 1991. 23p. Sponsored by USDOE, Washington, DC (USA); National Aeronautics and Space Administration, Washington, DC (USA); National Science Foundation, Washington, DC (USA). DOE Contract AC02-76CH03000. Grant 87-15412;Grant NAGW-1340. (CONF-9011188–1: Institute for Cosmic Ray Research (ICRR) international symposium on astrophysical aspects of the most energetic cosmic rays, Kofu (Japan), 26-29 Nov 1990). Order Number DE91009670. Source: OSTI; NTIS; INIS; GPO Dep.

The idea of production of ultrahigh-energy particles in the present universe due to annihilation or collapse of topological defects is discussed. Topological defects, formed in symmetry-breaking phase transitions in the early universe, can survive till today owing to their topological stability. However, under certain circumstances, topological defects may be physically destroyed. When topological defects are destroyed, the energy contained in the defects can be released in the form of massive gauge- and Higgs bosons of the underlying spontaneously broken gauge theory. Subsequent decay of these massive particles can give rise to energetic particles ranging up to an energy on the order of the mass of the original particles released from the defects. This may give us a "natural" mechanism of production of extremely energetic cosmic ray particles in the universe today, without the need for any acceleration mechanism. To illustrate this idea, I describe in detail the calculation of the expected ultrahigh-energy proton spectrum due to a specific process which involves collapse or multiple self-intersections of a class of closed cosmic string loops formed in a phase transition at a grand unification energy scale. I discuss the possibility that some of the highest-energy cosmic ray particles are of this origin. By comparing with the observational results on the ultrahigh-energy cosmic rays, we derive an upper limit to the average fraction of the total energy in all "primary" cosmic string loops that may be released in the form of particles due to collapse or multiple self-intersections of these loops. No nuclei such as α's or Fe's are in the spectrum. 43 refs., 3 figs.

15462 (IC–90/214) **Numerical simulation of a magnetic reconnection in the solar corona.** Wang Shui. International Centre for Theoretical Physics, Trieste (Italy). Aug 1990. 16p. Order Number DE91625352. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper, a kind of magnetic reconnection process caused by the local heating in the closed magnetic field region over the equator in the solar corona is discussed. At first, we use a method in combination with analytical and numerical methods to obtain a coronal magnetic configuration with X-type neutral point. Furthermore we solve numerically the magnetohydrodynamic equations by using the full-implicit continuous Eulerian scheme in the spherical coordinates. The results of numerical simulation show that three different processes of magnetic reconnection are existed. On the other hand, the upward plasma velocity is small when the effect of solar gravitational field is considered. Hence, we suggest that the magnetic reconnection caused by the pure resistivity tearing mode may be unimportant for the coronal mass ejections. (author). 37 refs, 2 figs.

15463 (IC–90/316) **On the determination of the Hubble constant.** Gurzadyan, V.G. (International Centre for Theoretical Physics, Trieste (Italy)); Harutyunyan, V.V.; Kocharyan, A.A. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 10p. Order Number DE91625368. Source: OSTI; NTIS (US Sales Only); INIS.

The possibility of an alternative determination of the distance scale of the Universe and the Hubble constant based on the numerical analysis of the hierarchical nature of the large scale Universe (galaxies, clusters and superclusters) is proposed. The results of computer experiments performed by means of special numerical algorithms are represented. (author). 9 refs, 7 figs.

15464 (IC–90/317) **An alternative approach to the statistical investigation of the large-scale structure of the universe.** Gurzadyan, V.G. (International Centre for Theoretical Physics, Trieste (Italy)); Harutyunyan, V.V.; Kocharyan, A.A. International Centre for Theoretical Physics, Trieste (Italy) Oct 1990. 10p. Order Number DE91625369. Source: OSTI; NTIS (US Sales Only); INIS.

A method of statistical investigation of filamentary structure of the Universe is developed enabling one to analyze the information both on its spatial and dynamical properties simultaneously. The idea is based on construction of subsystems of a hierarchical system by means of special numerical algorithm. The strength of the method is demonstrated via computer experiments. (author). 5 refs, 5 figs.

15465 (IC–90/318) **Can the anisotropy of microwave background radiation be discovered at present?.** Gurzadyan, V.G. (International Centre for Theoretical Physics, Trieste (Italy)); Kocharyan, A.A. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 12p. Order Number DE91625370. Source: OSTI; NTIS (US Sales Only); INIS.

An effect leading to a decrease of perturbations of Microwave Background Radiation after recombination epoch is investigated. Behaviour of correlation functions for null geodesics flow enables one to evaluate the role of this effect based purely on geometrical and topological properties of the Universe. Possible anisotropy of MwB in open Friedmannian Universe is shown to decrease due to this effect to a level far below present experimental accuracy. The fractal nature of the large scale structure of the Universe is also discussed. (author). 20 refs.

15466 (ITEF–180-89) **Characteristics of shock waves in neutrino-thick medium of collapsing stars.** Imshennik, V.S.; Murzina, M.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 28p. (In Russian). Order Number DE91623795. Source: OSTI; NTIS (US Sales Only); INIS.

Hugoniot relations for shock waves in neutrino-thick medium of colapsing stars are formulated. The equations obtained are solved numerically for rather wide range of shock wave velocities ($D=(1,3,5)\times10^9$ cm/s) as well as for values of medium physical parameters against the shock wave front (temperature $T=(3,5,10)\times10^{-9}$K; medium degree $\Theta_0=n_n/n_p=10;100$; at $\rho_0=10^{11}$ g/cm^3 density).Presence of neutrino radiation is shown to result in matter essential deneutronization (up to Θ=10-30) at shock wave passage though contribution of leptonic component into the matter main characteristics (pressure, internal energy, temperature etc.) is rather small. 17 refs.; 3 figs.; 3 tabs.

15467 (ITEF–182-89) **On picture cross section of photons or ultrarelativistic uncharged particles by charged black hole of Reissnee-Nordstrem.** Zakharov, A.F. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 8p. (In Russian). Order Number DE91623796. Source: OSTI; NTIS (US Sales Only); INIS.

Expression for capture cross section of photons (or uncharged ultrarelativistic particles) by spherically-symmetrical charged black hole was obtained. Known expressions for capture cross section of photons by Schwarzschild black hole and for capture cross section of photons by extremely charged black hole were derived by passing to the limit in mentioned expression. 7 refs.; 1 fig.

15468 (LAL–9020) **Search for macroscopic dark matter in the halo of the milky way through microlensing. A feasibility study.** Moniez, M. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. May 1990. 10p. (CONF-9003259–: 10. Moriond Astrophysics Meeting, Les Arcs (France), 4-10 Mar 1990). Order Number DE91767823. Source: OSTI; NTIS (US Sales Only).

The possibility of searching for non-visible massive compact objects in the galactic halo is discussed here. The discovery of such objects would solve the problem of the missing mass in the galaxies, and the experiments which investigate for weakly interacting particles assuming a diffuse cloud of dark matter would have to revise their limits. The non-discovery of these objects would exclude the last possibility left for baryonic dark matter, providing good evidence that the galactic halo has to be made of new particles. The description of the general-relativistic microlensing effect and its application to the search of massive compact objects are given here. A feasibility study shows that it is possible to monitor the luminosity of several million stars in the Large Magellanic Cloud with the required precision, in order to detect a possible microlensing phenomenon induced by heavy compact objects (10^{-4} - 10^{-1} solar mass units). A CCD-based experimental setup is described, which would make it possible to search for compact objects in the 10^{-6} - 10^{-4} solar mass unit domain.

15469 (NIIYaF-MGU–89-35-112) **Nonlinear plasma vortices in the Jupiter magnetosphere and radial diffusion in the radiation belt.** Kropotkin, A.P.; Mozzhukhina, A.R. Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1989. 16p. (In Russian). Order Number DE91623793. Source: OSTI; NTIS (US Sales Only); INIS.

Within the framework of representations about two-dimensional vortex character of hydrodynamic turbulence in Jo torus linked with the development of rearrangement (flute) instability of torus plasma, non-linear equations describing such disturbances with regard to ionospheric conductivity effect are derived. Evaluations of chacteristic size of a vortex and value of electric field disturbances are found. Energetic particle radial diffusion coefficient in the Jo torus region is calculated, radial diffusion equation with model losses is solved. 23 refs.; 3 figs.

15470 (NORDITA–90/60-A(prepr.)) **The velocity dispersion gradients in spiral galaxies. Pt. 1: The galaxy and NGC 3198.** Antonuccio-Delogu, V. (Nordisk Inst. for Teoretisk Fysik (NORDITA), Copenhagen (Denmark)). Nordisk Inst. for Teoretisk Fysik (NORDITA), Copenhagen (Denmark). 1990. 45p. Order Number DE91623833. Source: OSTI; NTIS (US Sales Only); INIS.

An attempt to model the observed radial velocity dispersion profiles for our Galaxy and NGC 3198 by using exact solutions of Jeans equations is presented. No use is made of the epicyclic approximations, so our solutions can be applied quite generally to model the velocity dispersions in the plane of axisymmetric collisionless systems. Quite satisfactory fits are obtained by assuming that the isotropy parameter $\beta=\sigma_\Phi/\sigma_r$ of the stellar component is minimal. We then consider the possibility of constraining models of the mass distribution of a spiral by using the velocity dispersion profile. For our Galaxy, using the data of Lewis and Freeman (1989) and Woodley et al. (1977), no firm conclusions about the best fitting mass model can be reached, mainly because the data are incomplete and affected by observational uncertainties. For NGC 3198, although the solutions fit the observations quite well, the observational errors do not allow any strong constraint on the mass models. (orig.).

15471 (NORDITA–90/64-AP(prepr.)) **Cosmology of the standard model dilaton.** Enqvist, K. Nordisk Inst. for Teoretisk Fysik (NORDITA), Copenhagen (Denmark). 1990. 9p. Order Number DE91623850. Source: OSTI; NTIS (US Sales Only); INIS.

The cosmological evolution of the Standard Model dilaton-Higgs system is considered. We solve the dilaton equation of motion and find the condition for the thermalization and the freeze-out of dilatons. It is shown that the energy density in the subsequent dilaton oscillations is diluted by the large entropy production of the delayed electroweak phase transition. Hence the Standard Model dilaton is cosmologically safe. (orig.).

15472 (NORDITA–90/65-A(prepr.)) **The DBAQ G35-26.** Thejll, P. (Nordisk Inst. for Teoretisk Fysik (NORDITA), Copenhagen (Denmark)); MacDonald, J.; Shipman, H.L. Nordisk Inst. for Teoretisk Fysik (NORDITA), Copenhagen (Denmark). 1990. 9p. Grant NASA NAG 5-972;NSF AST-87-20530. (CONF-9009358–: European white dwarf workshop, Toulouse (France), 7 Sep 1990). Order Number DE91623797. Source: OSTI; NTIS (US Sales Only); INIS.

The DQ G35-26 is spectroscopically analyzed and the results discussed in the context of dredge-up of carbon and the accretion of hydrogen. The best fit is T_{eff}=13,000K with firm limits between 11,000K and 14,000K, log(g) between 9.0 and 9.5. The hydrogen abundance is close to 1% by number and the carbon abundance close to 3%. All other elements have less than solar abundance. (orig.).

15473 (NORDITA–90/66-A(prepr.)) **The effective temperature of the DBV's, and the sensitivity of DB model atmospheres to input physics.** Thejll, P. (Nordisk Inst. for Teoretisk Fysik (NORDITA), Copenhagen (Denmark)); Vennes, S.; Shipman, H.L. Nordisk Inst. for Teoretisk Fysik (NORDITA), Copenhagen (Denmark). 1990. 9p. Grant NASA NAG 5-348;NSF AST-87-20530. (CONF-9009358–: European white dwarf workshop, Toulouse (France), 7 Sep 1990). Order Number DE91623798. Source: QSTI; NTIS (US Sales Only); INIS.

A new grid of DB models is applied to the problem of the DBV temperatures and the DB gap. It is found that the DBV instability strip lies lower than thought before. This has consequences for the calibration of mixing-length theories and the reality of the DB gap. The DBV GD358 is discussed in detail. (orig.).

15474 (NORDITA–90/67-A(prepr.)) **Turbulent dynamo action in stars.** Brandenburg, A. (Nordisk Inst. for Teoretisk Fysik (NORDITA), Copenhagen (Denmark)); Jennings, R.L.; Nordlund, A.; Rieutord, M.; Ruokolainen, J. Nordisk Inst. for Teoretisk Fysik (NORDITA), Copenhagen (Denmark). 1990. 13p. Order Number DE91623799. Source: OSTI; NTIS (US Sales Only); INIS.

The way in which dynamo action amplifies magnetic fields in the Sun, the Earth, and indeed galaxies is a classic problem of theoretical physics. Here we present the results of direct simulations of turbulent compressible hydromagnetic convection with a stable overshoot layer underneath (to model the Sun). We find spontaneous dynamo action followed by saturation, with most of the generated magnetic field appearing as coherent flux tubes in the vicinity of strong downdrafts. Here both the generation and destruction of magnetic field is at its most vigorous, and which process ultimately dominates depends on the sizes of the magnetic Reynolds and magnetic Prandtl numbers. (orig.).

15475 (NORDITA–90/68-AP(prepr.)) **Inert neutrinos in supernovae.** Kainulainen, K. (Nordisk Inst. for Teoretisk Fysik (NORDITA), Copenhagen (Denmark)); Maalampi, J.; Peltoniemi, J.T. Nordisk Inst. for Teoretisk Fysik (NORDITA), Copenhagen (Denmark). 1990. 17p. Order Number DE91623800. Source: OSTI; NTIS (US Sales Only); INIS.

We study the constraints the observations of the supernova SN1987A impose on the mixing of the electron neutrino with an inert neutrino. A part of the electron neutrinos produced in the core of the star convert themselves into inert neutrinos as a result of the mixing. They would then escape the core and cool the star very rapdily in contrast to the observations. We show that due to matter effects the mixing or relatively light states propagating in the core is strongly suppressed, so that essentially no bounds exist if the mass of the inert neutrino is less than 200 eV. We also give a wave packet treatment of the propagation and the mixing of a neutrino state in matter, and find a condition for the ceasing of the oscillations due to the separation of the wave packets. (orig.).

15476 (NORDITA–90/73-A(prepr.)) **Chemical evolution of galaxies.** Pagel, B.E.J. Nordisk Inst. for Teoretisk Fysik (NORDITA), Copenhagen (Denmark). 1990. 11p. (CONF-9009325–: International Union of Pure and Applied Physics (IUPAP) conference on primordial nucleosynthesis and evolution of the early universe, Tokyo (Japan), 3-8 Sep 1990). Order Number DE91623834. Source: OSTI; NTIS (US Sales Only); INIS.

Initial conditions are probably set by results of Big Bang nucleosynthesis (BBNS) without intervening complications affecting the composition of visible matter so that extrapolation of observed abundances to BBNS products seems fairly secure. Primordial helium and deuterium abundances deduced in this way place upper and lower limits on baryonic density implying that both baryonic and non-baryonic dark matter exist and predicting no more than 3 neutrino flavours as recently confirmed in accelerator experiments. The validity of simple galactic chemical evolution models assumed

in extrapolating back to the Big Bang is examined in the light of the frequency distribution of iron or oxygen abundances in the Galactic halo, bulge and disk. (orig.).

15477 (UCRL-JC-105642) **Relativistic shock waves and the excitation of plerions.** Arons, J. (California Univ., Berkeley, CA (USA)); Gallant, Y.A.; Hoshino, Masahiro; Max, C.E.; Langdon, A.B. California Univ., Livermore, CA (USA). Inst. of Geophysics and Planetary Physics. 7 Jan 1991. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9106119-1: IAU colloquium 128: the magnetospheric structure and emission mechanisms of radio pulsars', Logow (Poland), 18 Jun 1991). Order Number DE91007623. Source: OSTI; NTIS; GPO Dep.

The shock termination of a relativistic magnetohydrodynamic wind from a pulsar is the most interesting and viable model for the excitation of the synchrotron sources observed in plerionic supernova remnants. We have studied the structure of relativistic magnetosonic shock waves in plasmas composed purely of electrons and positrons, as well as those whose composition includes heavy ions as a minority constituent by number. We find that relativistic shocks in symmetric pair plasmas create fully thermalized distributions of particles and fields downstream. Therefore, such shocks are not good candidates for the mechanism which converts rotational energy lost from a pulsar into the nonthermal synchrotron emission observed in plerions. However, when the upstream wind contains heavy ions which are minority constituent by number density, but carry the bulk of the energy density, much of the energy of the shock goes into a downstream, nonthermal power law distribution of positrons with energy distribution $N(E)dE \propto E^{-s}$. In a specific model presented in some detail, s = 3. These characteristics are close to those assumed for the pairs in macroscopic MHD wind models of plerion excitation. The essential mechanism is collective synchrotron emission of left-handed extraordinary modes by the ions in the shock front at high harmonics of the ion cyclotron frequency, with the downstream positrons preferentially absorbing almost all of this radiation, mostly at their fundamental (relativistic) cyclotron frequencies. Possible applications to models of plerions and to constraints on theories of energy loss from pulsars are briefly outlines. 27 refs., 5 figs.

15478 (UCRL-JC-105643) **Magnetospheric structure of rotation powered pulsars.** Arons, J. (California Univ., Berkeley, CA (USA)). Lawrence Livermore National Lab., CA (USA). 7 Jan 1991. 42p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9106119-2: IAU colloquium 128: the magnetospheric structure and emission mechanisms of radio pulsars', Logow (Poland), 18 Jun 1991). Order Number DE91007622. Source: OSTI; NTIS; GPO Dep.

I survey recent theoretical work on the structure of the magnetospheres of rotation powered pulsars, within the observational constraints set by their observed spindown, their ability to power synchrotron nebulae and their ability to produce beamed collective radio emission, while putting only a small fraction of their energy into incoherent X- and gamma radiation. I find no single theory has yet given a consistent description of the magnetosphere, but I conclude that models based on a dense outflow of pairs from the polar caps, permeated by a lower density flow of heavy ions, are the most promising avenue for future research. 106 refs., 4 figs., 2 tabs.

6402 Atmospheric Physics

Refer also to citation(s) 14733

15479 (KFTI-89-2) **Numerical simulation of transients in plasma near the variable potential negative charged body.** Pavlenko, N.G.; Bliokh, Yu.P.; Zejdlits, V.P.; Tkach, Yu.V.; Kharchenko, I.F. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1989. 7p. (In Russian). Order Number DE91624481. Source: OSTI; NTIS (US Sales Only); INIS.

Theoretical study is made on plasma dynamics near space vehicle (SV) injecting ion beam at initial stage of active experiments in ionosphere. It is shown that occurrence of negative potential at SV leads to formation of positively charged layer adjoining its surface with size and oscillation amplitude depending on the value and potential increase velocity. 6 refs.; 5 figs.

15480 (NEI-NO-117) **Reconstruction of energetic electron spectra in the upper atmosphere: balloon observations of auroral X-rays coordinated with measurements from the EISCAT radar.** Olafsson, K.J. Bergen Univ. (Norway). Aug 1990 141p. Order Number DE91624482. Source: OSTI; NTIS (US Sales Only); INIS.

Energetic electron precipitation in the auroral zone has been studied using coordinated auroral X-ray measurements from balloons, altitude profiles of the ionospheric electron density measured by the EISCAT radar above the balloons, and cosmic noise absorption data from the Scandinavian riometer network. The data were obtained during the Coordinated EISCAT and Balloon Observations (CEBO) campaign in August 1984. The energy spectral variations of both the X-ray fluxes and the primary precipitating electrons were examined for two precipitation events in the morning sector. As far as reasonably can be concluded from observations of magnetic activity in the auroral zone, and from the temporal development of the energy spectra, the two precipitation events can be interpreted in the frame of present models of energetic electron precipitation on the mordning side of the auroral zone. 96 refs., 70 figs., 11 tabs.

15481 (PPPL-2742) **Theory of ultra-low-frequency magnetic pulsations in the earth's magnetosphere.** Chen, Liu. Princeton Univ., NJ (USA). Plasma Physics Lab. Mar 1991. 19p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03073. Order Number DE91011104. Source: OSTI; NTIS; INIS; GPO Dep.

Long-period (T = 10-600 s) geomagnetic pulsations are known to be associated with magnetohydrodynamic (MHD) perturbations in the Earth's magnetosphere. Broadly speaking, there are two categories of excitation mechanisms. The first category corresponds to impulsive/external excitations, where MHD waves exhibit the stable discrete as well as continuous spectra. The second category corresponds to spontaneous/internal excitations, where MHD instabilities are excited either reactively or via wave-particle interactions. In this tutorial lecture, we briefly review theories concerning both categories of excitation mechanisms and compare theoretical predictions with available satellite observations. 20 refs.

15482 (RAL-90-073) **Electrons in the boundary layers near the dayside magnetopause.** Hall, D.S. (Rutherford Appleton Lab., Chilton (UK)); Chaloner, C.P.; Bryant, D.A.; Lepine, D.R.; Tritakis, V.P. Rutherford Appleton Lab., Chilton (UK). Oct 1990. 72p. Order Number DE91624483. Source: OSTI; NTIS (US Sales Only); INIS.

Accepted for publication in Journal of Geophysical Research.

Entry of heated solar-wind plasma into the magnetosphere is examined using electron distributions. In particular, the angular structure of the electron distributions is studied within the transition region separating the magnetosheath from the inner magnetosphere. The measurements suggest that electrons in the outer part of the transition region originate in the magnetosheath, whilst the population closer to the Earth consists of electrons from the magnetosphere combined with an energized magnetosheath component. This energized component contains "counterstreaming" electrons, which are confined to directions closely parallel and antiparallel to the magnetic field direction. The possibilities, that the energization of the counterstreaming electrons is cumulatively gained from either waves, electric fields perpendicular to the magnetic field, or quasi-Fermi acceleration, are discussed. It is not possible to identify the topology of the magnetic fields of the outer part of the region, but there is strong evidence that the inner part is on closed magnetic field lines, which map to the dayside auroral zone. The outer part of the transition region is a plasma depletion/magnetic-field compression layer. The structure of the transition region is similar to that surrounding flux transfer events, which leads to the deduction that the plasma and field signatures of flux transfer events may be the result of displacement of the transition region earthwards. Cases where the displacement is such that the field maximum of the depletion/compression region is encountered, may well explain "crater" flux transfer event signatures. (author).

6403 Atomic, Molecular, and Chemical Physics

Refer also to citation(s) 14971, 14974, 14994, 15062, 15063, 15107, 15654, 15872, 15980, 16011

15483 (CONF-9103146–1) **Electron correlation explored through electron spectrometry using synchrotron radiation.** Caldwell, C.D. (University of Central Florida, Orlando, FL (USA). Dept. of Physics); Whitfield, S.B.; Flemming, M.G.; Krause, M.O. Oak Ridge National Lab., TN (USA). [1991]. 9p. Sponsored by US-DOE, Washington, DC (USA); National Science Foundation, Washington, DC (USA). DOE Contract AC05-84OR21400. Grant PHY-8907286. From 3. US/Mexico atomic and molecular physics workshop; Mexico City (Mexico); 13-16 Mar 1991. Order Number DE91009917. Source: OSTI; NTIS; INIS; GPO Dep.

The development of synchrotron radiation facilities as a research tool has made possible experiments which provide new insights into the role which correlation plays in electron dynamics and atomic and molecular structure. Features such as autoionizing resonances, normal and resonant Auger decay modes, and ionization threshold structure have become visible in a wealth of new detail. Some aspects of this information drawn from recent experiments on the alkaline earth metals and the rare gases are presented. The potential for increased flux and resolution inherent in insertion device-based facilities like the Advanced Light Source should advance this understanding even further, and some future directions are suggested. 8 refs., 8 figs.

15484 (CONF-9103146–2) **Low-energy collisions of multiply charged ions with electrons, atoms and surfaces.** Phaneuf, R.A. (Oak Ridge National Lab., TN (USA)); Meyer, F.W.; Gregory, D.C.; Havener, C.C.; Zeijlmans van Emmichoven, P.A.; Overbury, S.H.; Zehner, D.M.; Dunn, G.H.; Thompson, J.S.; Waahlin, E.K.; Smith, A.C.H. Oak Ridge National Lab., TN (USA). [1991]. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 3. US/Mexico atomic and molecular physics workshop; Mexico City (Mexico); 13-16 Mar 1991. Order Number DE91010779. Source: OSTI; NTIS; INIS; GPO Dep.

Results are presented from recent experiments at the ORNL-ECR Multicharged Ion Research Facility which have addressed low-energy interactions of multiply charged ions with electrons, hydrogen atoms and metal surfaces. The specific processes for which results are reported are electron-impact excitation, electron capture and ion neutralization. The objective of these studies is a more detailed understanding of the mechanisms which govern the interactions of multicharged ions at low (or near-threshold) collision energies. 18 refs., 8 figs.

15485 (DOE/ER/13262–7) **Excitation of atoms and molecules in collisions with highly charged ions: Progress report, January 1, 1990–March 1, 1991.** Watson, R.L. Texas A and M Univ., College Station, TX (USA). Cyclotron Inst. 1 Mar 1991. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-84ER13262. Order Number DE91010740. Source: OSTI; NTIS; INIS; GPO Dep.

Much of the work this year has been directed toward studies of charge exchange and ionization in single collisions of heavy ions with gaseous atoms and molecules. A study of the double ionization of He by high energy N^{7+} ions, which began last year, was extended up in energy to 40 MeV/amu. These measurements verified the deviations from the predictions of theory observed in our previous work and indicated that the energy required to reach the limiting value of the ratio of double-to-single ionization cross sections may be as high as 70 MeV/amu.

15486 (GSI–90-28) **Study of the reaction dynamics of heavy ion reactions via δ electron spectroscopy.** Stroth, J. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.); Mainz Univ. (Germany, F.R.). Inst. fuer Physik. Nov 1990. 126p. (In German). Order Number DE91764639. Source: OSTI; NTIS (US Sales Only); INIS.

In the present thesis measurements of δ electron spectra in the energy range 0.2 MeV < E_e < 3.5 MeV in elastic and deep inelastic nuclear collisions are described, which were performed at the heavy ion accelerator UNILAC of GSI in Darmstadt. For the collisional system U+Au at a uranium beam energy of 8.65 MeV/u as well as for U+Er and U+Pd at 6.1 MeV/u δ electron spectra from elastic and quasi-elastic scattering were compared with calculations of the coupled-channel model. In the system U+Au a very good agreement is found until down to impact parameters in the grazing range. Also in the lighter systems the agreement for long-range collisions is good, however the calculations subestimate the absolute value of the spectra by about 15% (U+Er) and 30% (U+Pd). The δ electron spectra for elastic scattering are also well described by the one-stage model. Regarding the extended charge distribution of the nuclei values for the mean binding energy of the electron of 600 keV (U+Au) and 340 keV (U+Er) are obtained. In the δ electron spectra for dissipative U+Au collisions the influence of an increasing time delay with growing energy loss is distinctly to be observed. In the interpretation of the spectra by means of phenomenological trajectories a maximal reaction time of 1.1×10^{-2} at a mean energy loss of 370 MeV is to be observed. The reaction times increase nearly linearly with the energy loss of the reaction. The explorative measurements of dissipative collisions at the Coulomb threshold in the system U+Pd at 6.1 MeV/u have shown that here the background contribution to the electron spectrum from conversion electrons can amount up to 50%. Because in the calculation of the background there still exist certain uncertainties concerning the multipolarity contributions of the γ radiation a reaction analysis was not yet possible here. (orig./HSI).

15487 (GSI–91-01(prepr.)) **Non-perturbative character of electron-positron pair production in relativistic heavy-ion collisions.** Rumrich, K. (Frankfurt Univ. (Germany, F.R.). Inst. fuer Theoretische Physik); Momberger, K.; Gruen, N.; Scheid, W.; Greiner, W.; Soff, G. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Jan 1991. 12p. Order Number DE91764564. Source: OSTI; NTIS (US Sales Only); INIS.

Coupled-channel calculations for relativistic heavy-ion collisions are performed in order to determine the electromagnetic electron-positron pair production yield with subsequent capture of the electron into the K-shell of the target. We consider heavy projectiles impinging on Pb^{82+} and U^{92+} with small impact parameters at a bombarding energy of 1.2 GeV/u and 2 GeV/u, respectively. The dependence of the positron yields on the charge number of the projectile exhibits a strong non-perturbative feature. The corresponding result obtained within first-order perturbation theory is exceeded by about two orders of magnitude. (orig.).

15488 (IAE–4760-1) **Calculation aspects of the solution of one-dimensional nuclear Schroedinger equation with two-well numerical potential.** Gusev, V.V.; Potapov, S.G.; Sukhanov, L.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 32p. (In Russian). Order Number DE91623547. Source: OSTI; NTIS (US Sales Only); INIS.

As an example of quantum mechanical system He-M^+-He (M^+=H^+, μ^+), the calculation aspects of solution with finite-element method of one-dimensional nuclear Schroedinger equation with two- well numerical potential that is in given case calculated in Hartree-Fock-Roothaan approximation are discussed. The influence of the external and the internal sources of errors on the accuracy of calculation of relative spectral characteristics, i.e. the values of tunnelling splitting of levels and of the transition energies between them is investigated. For the problems of such type the checked accuracy of calculation of the values of tunnelling splitting of levels and of the transition energies between them that is defined by the relative accuracy of potential description is established. 17 refs.; 2 figs.; 11 tabs.

15489 (IAEA-NDS–58(Rev.2)) **ENDF/B-6 Photon Atomic Interaction Data Library: Summary documentation.** Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1990. 29p. Order Number DE91623573. Source: OSTI; NTIS (US Sales Only); INIS.

The ENDF/B-6 version of the Photo-Atomic Interaction Data Library of the Livermore Evaluated Photon Data Library (EPDL) contains pair and triplet cross-sections, photoelectric cross-sections, atom form factors, coherent scattering cross-sections and some other data for all the elements from Z=1 to 100. The data library is available on magnetic tape costfree from the IAEA Nuclear Data Section. The library supersedes the earlier photo-atomic data

library by the US Radiation Shielding Information Center RSIC that was included in the data libraries ENDF/B-5 and JEF-1. (author). Refs, figs and tabs.

15490 (IC–90/300) **A study of the kinetic energy density functional for atoms.** Delchev, Ya.I. (International Centre for Theoretical Physics, Trieste (Italy)); Pavlov, R.L.; Petkov, I.Zh.; Velchev, Ch.I. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 26p. Order Number DE91625242. Source: OSTI; NTIS (US Sales Only); INIS.

This paper studies the rigorous kinetic energy density functional at the level of the Hartree-Fock method for closed electron shell atoms. The behaviour of the kinetic energy and its components, is analysed as the atomic number N increases. It is shown that the increments of the specific energies for two consecutive closed electron shells atoms depend distinctly on the electron configuration of the last electron shell. 35 refs, 1 fig., 4 tabs.

15491 (IC–90/308) **Some remarks about a role of a back recombination in RC primary processes.** Barvik, I. (International Centre for Theoretical Physics, Trieste (Italy)); Nedbal, L. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 23p. Order Number DE91625243. Source: OSTI; NTIS (US Sales Only); INIS.

We give a model of radical pair states in plant photosystem I and all possible kinds of excitation transitions between them. Our numerical modelling results in conclusions about a principal role of a back recombination in an explanation of new experimental results, namely biphasic time dependence of a delayed fluorescence. (author). 24 refs, 4 figs.

15492 (IC–90/309) **Coherent memory functions for finite systems: hexagonal photosynthetic unit.** Barvik, I. (International Centre for Theoretical Physics, Trieste (Italy)); Herman, P. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 10p. Order Number DE91625244. Source: OSTI; NTIS (US Sales Only); INIS.

Coherent memory functions entering the Generalized Master Equation are presented for an hexagonal model of a photosynthetic unit. Influence of an energy heterogeneity on an exciton transfer is an antenna system as well as to a reaction center is investigated. (author). 9 refs, 3 figs.

15493 (IC–90/310) **Trapping effects in exciton motion in the framework of CTRW.** Barvik, I. (International Centre for Theoretical Physics, Trieste (Italy)); Herman, P. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 12p. Order Number DE91625245. Source: OSTI; NTIS (US Sales Only); INIS.

Influence of a trap (sink) on an exciton transfer in molecular aggregates is investigated. Pausing time distribution functions $phi^{P}_{m}(t)$ and probability densities $Q_{mn}(t)$ on the continuous time random walk theory are calculated from memory functions entering the generalized master equations. The presence of the sink changes their analytical form. We used trimmer as example to show that only for large trapping rates pausing time distribution functions become nonnegative. Only in this case they could be used in Monte Carlo modelling. (author). 14 refs, 2 figs.

15494 (IC–90/311) **Effect of trapping on transport coherence.** Barvik, I. (International Centre for Theoretical Physics, Trieste (Italy)); Herman, P. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 11p. Order Number DE91625246. Source: OSTI; NTIS (US Sales Only); INIS.

Influence of a trap (sink) on an exciton transfer in molecular aggregates is investigated. Memory functions entering the generalized master equations are calculated. The presence of the sink changes their analytical form. We used the sink in trimer as example to show that for large trapping rate parameters the rest of the system is decoupled from the sink. (author). 8 refs, 2 figs.

15495 (INIS-SU–233, pp. 10-16) **Calculation of energy of helium-like ion $2p^2\ ^3P$, ^1D, ^1S double-excited states and lithium-like ion $1s2p^2\ ^4P$ states.** Nadykto, B.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 38p. (In Russian). In *Theoretical and applied physics: Scientific-technical collection.* Order Number DE91003083. Source: OSTI; NTIS (US Sales Only); INIS.

Energy values of $2p^2\ ^3P$, ^1D, ^1S double-excited states of helium-like ions and $1s2p^2\ ^4P$ states of lithium-like ions, calculated using an improved Bohr atom model are presented. Calculation results show that electron interaction in $2p^2$ configuration does not depend on the presence and quantity of electrons in the external shell in 1s state. The calculated energy values for ions with Z=2-100 are presented. 8 refs.; 9 tabs.

15496 (IYaF–88-142) **Laser spectroscopy of atomic samarium.** Barkov, L.M.; Melik-Pashaev, D.A.; Zolotorev, M.S. AN SSSR, Novosibirsk (USSR). Inst. Yadernoj Fiziki. 1988. 52p. Order Number DE91623549. Source: OSTI; NTIS (US Sales Only); INIS.

Samarium spectrum was studied with a purpose to find transitions to be used in experiments on parity nonconservation. Macaluso-Corbino effect - Faraday rotation near resonance was used for the search and study of spectral lines. We have identified previously unknown energy levels belonging to the $4f^6 6s^2\ ^5D$ term: 15914.55(3) cm^{-4} (J=1), 17864.29(3) cm^{-4} (J=2), 20195.76(3) cm^{-4} (J=3). M1-transitions to these levels from the levels of the ground $4f^6 6s^2\ ^7F$ term were observed. There are several peculiarities of these transitions which are due to the fact that they occut within an inner $4f^5$-shell, particularly, a very small presuure broadening by inert gases. 44 refs.; 17 figs.; 7 tabs.

15497 (IYaF–89-92) **Complex of programs for atomic physics problems. Self-consistent field method.** Dzyuba, V.A. AN SSSR, Novosibirsk (USSR). Inst. Yadernoj Fiziki. 1989. 25p. (In Russian). Order Number DE91623550. Source: OSTI; NTIS (US Sales Only); INIS.

Realization of the Hartree-Fock-Sleiter and Hartree-Fock methods in the relativistic version is described. Their use permits to calculate energy levels, fine and superfine structure ranges, E1 and M1 amplitudes etc. for any atoms in the central-symmetric field approximation, as well as to find the whole orthonormalized set of states for discrete and continuous spectra, necessary for taking into account polarization and correlation effects according to the multi-particle perturbation theory. 21 refs.

15498 (LAL-RT–9004) **Short pulse photoemission from a dispenser cathode.** Bergeret, H.; Boussoukaya, M.; Chehab, R.; Leblond, B.; Le Duff, J. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Jun 1990. 9p. Contract 88-118-DRET. (CONF-9006242–: Workshop on short pulse high current cathodes, Bendor (France), 18-22 Jun 1990). Order Number DE91767808. Source: OSTI; NTIS (US Sales Only).

Pulsed photoemission in picosecond regime has been obtained from a standard thermionic dispenser cathode (W - Ba - Ca) at temperatures below measurable thermoemission threshold. A picosecond Nd: YAG mode locked laser has been used at both green and U.V. light. Micro-pulse charges up to 0.5 nC have been measured on a wideband coaxial pick up located behind the anode. They correspond to an electron saturation limit from an approximately 20 mm^2 illuminated cathode area with a surface field of 3 MV/m. The effective cathode efficiency at small laser energies, defined as the number of electron impinging the coaxial pick up divided by the number of photons impinging the cathode, is about 2.10^{-5}.

15499 (LAMP–90/3) **High resolution laser spectroscopy in cold supersonic molecular beams. Cooling, reduction of Doppler width and applications.** LAMP series report (Laser, Atomic and Molecular Physics). Mehdizadeh, E. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 22p. Order Number DE91623551. Source: OSTI; NTIS (US Sales Only); INIS.

The cooling of molecules during the adiabatic expansion of supersonic seeded molecular beams is reviewed and illustrated by the example of NO_2-molecules. The reduction of the Doppler-width by collimation of the beam and the cooling to low rotational temperatures brings a significant simplification of the complex NO_2-absorption spectrum and allows its assignment. The measured rotational temperature was T_{rot} = 10K. Some examples from our work illustrate this promising technique of high resolution laser spectroscopy in cold beams. (author). 17 refs, 4 figs.

15500 (LIYaF–1474) **Quantum chemical simulation of hydrogen like states in silicon and diamond.** Gel'fand, R.B. (AN Belorusskoj SSR, Minsk (Byelorussian SSR). Inst. Fiziki Tverdogo Tela i Poluprovodnikov); Gordeev, V.A.; Gorelkinskij, Yu.V. AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki. 1989. 36p. (In Russian). Order Number DE91623552. Source: OSTI; NTIS (US Sales Only); INIS.

The quantum-chemical methods of the complete neglect of differential overlap (CNDO) and intermediate neglect of differential overlap (INDO) are used to calculate the electronic structure of atomic hydrogen (muonium) located at different interstital sites of the silicon and diamond crystal lattices. The electronic g- and hyperfine interaction tensors of the impure atom are determined.The results obtained are compared with the experimental data on the 'normal' (Mu') and 'anomalous' (Mu^*) muonium centers as well as on the hydrogen-bearing Si-AA9 EPR center which is a hydrogen-bearing analogue of (Mu^*). The most likely localization sites for hydrogen (muonium) atoms in silicon and diamond crystals are established. 22 refs.

15501 (LIYaF–1489) **K-shell photoionization cross sections.** Band, I.M. (AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki); Trzhaskovskaya, M.B.; Verner, D.A.; Yakovlev, D.G. AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki. 1989. 26p. (In Russian). Order Number DE91623553. Source: OSTI; NTIS (US Sales Only); INIS.

Simple analytic formulae are proposed to fit the theoretical K-shell photoionization cross sections of atoms and ions. The numerical parameters which enter these formulae are presented for atoms and ions with charge number Z=2 and $6 \leq Z \leq 26$. 11 refs.; 2 figs.

15502 (NIFS-DATA–8) **Excitation collision strengths, cross sections and rate coefficients for OV, SIXI, FeXXIII, MoXXXIX by electron impact ($1s^2 2s^2$-$1s^2 2s 2p_1 s^2 2p^2$ transitions).** Safronova, U.I.; Kato, T.; Masai, K.; Vainshtein, L.A.; Shlyapzeva, A.S. National Inst. for Fusion Science, Nagoya (Japan). Dec 1990. 93p. Order Number DE91767978. Source: OSTI; NTIS (US Sales Only); INIS.

Excitation collision strengths, cross sections and rate coefficients by electron impact are calculated for the transitions among the $1s^2 2s^2$, $1s^2 2p^2$, $1s^2 2s 2p$ levels of Be-like system of OV, SiXI, FeXXIII and MoXXXIX ions by Coulomb-Born approximation with exchange including relativistic effect and configuration interactions. The theoretical method for calculation is described and the results are compared with the previous calculations. Numerical data and comparison are presented in Tables as well as in Figures. Two kinds of fitting formulae for cross sections and rate coefficients are discussed. (author).

15503 (ORNL/FTR–3875) **[Few-body problems, electron-correlation effects, and beyond]: Foreign trip report, March 13, 1991–March 17, 1991.** Phaneuf, R.A. Oak Ridge National Lab., TN (USA). 1 Apr 1991. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010030. Source: OSTI; NTIS (US Sales Only); GPO Dep.

The Third US-Mexico Cooperative Joint Symposium on Atomic and Molecular Physics drew 50 participants from Mexico, the United States, and Europe. The theme of the symposium/workshop was "Few-body problems, electron-correlation effects, and beyond." Among the 42 invited speakers were many distinguished atomic physicists who presented recent research results and perspectives in a workshop atmosphere. A well-balanced program covered most aspects of atomic and molecular collision physics. Particular excitement was generated by new experimental results reported for laser-stimulated radiative recombination of electrons with protons, and by theoretical results on the role of "scarred" wavefunctions as manifestations of classical chaos in photoionization.

15504 (ORNL/FTR–3876) **[Linac-based "Slow Positron Factory" facility]: Foreign trip report, February 24, 1991–March 10, 1991.** Hulett, L.D. Jr. Oak Ridge National Lab., TN (USA). 18 Mar 1991. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010241. Source: OSTI; NTIS; GPO Dep.

The Japan Atomic Energy Research Institute (JAERI) is considering the building of a linac-based "Slow Positron Factory" facility at the Takasaki Radiation Chemistry Research Establishment. An expenditure of $130M is anticipated. The facility will be similar to the ORELA slow positron facility at ORNL. Dr. S. Okada from Takasaki has visited ORNL twice for consulting. The main purpose of the Tokyo workshop was to allow JAERI headquarters to evaluate the field of slow positron applications and decide whether or not to commit funding. At this workshop the traveler presented the honorary invited lecture on linac-based slow positron sources and their applications. The positron experts meeting at Tsukuba University was a technical dialogue researchers on positron applications. It is noteworthy that Japanese industries such as Hitachi and NEC were heavily represented at this meeting. They are making use of positron technology and are sponsoring research. At the Takasaki Radiation Chemistry Research Establishment the traveler visited the site of the future "Positron Factory."

15505 (PPPL–2748) **Quenching of Einstein A-Coefficients in plasmas and lasers.** Suckewer, S. (Princeton Univ., NJ (USA). Plasma Physics Lab.). Princeton Univ., NJ (USA). Plasma Physics Lab. Mar 1991. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03073. Order Number DE91009849. Source: OSTI; NTIS; INIS; GPO Dep.

The coefficient of spontaneous emission (Einstein A-coefficient) is considered to be one of the basic constants of a given transition in atom or ion. The formula for the Einstein A-coefficient was derived in the pioneering works of Weisskopf and Wigner (WW) based on Dirac's theory of light. More recently, however, it was noted in several papers that the rate of spontaneous radiative decay can deviate significantly from the WW expression in certain conditions, for example in a laser cavity. A different type of change in A- coefficients was inferred from measurements of changes in the intensity branching ratio of spectral lines in a plasma. A change of branching ratio of up to a factor of 10 was observed in CIV for 3p-3s (580.1–581.2nm) and 3p-2s (31.2-nm) transitions when the electron density changed from approximately $N_e \approx 1 \times 10^{18}$ to 5×10^{18} cm^{-3}. This effect was also observed in CIII and NV. An initial theoretical approach to the problem based on the integration of the Schroedinger equation with the ion Coulomb potential modified by the electron cloud within the Debye radius was unsuccessfully in predicting the experimental observations. The effect of quenching of spontaneous emission coefficients was observed also in an Ar-ion laser as a function of the intracavity power density (photon density) for lines originating from the same upper level as the lasing line. Measurements of these line profiles absorption for different lasing conditions and related discussions are also presented. 14 refs., 6 figs.

15506 (RAL–89-136) **Intermultiplet transitions using neutron spectroscopy.** Osborn, R. (Rutherford Appleton Lab., Chilton (UK)); Lovesey, S.W.; Taylor, A.D.; Balcar, E. Rutherford Appleton Lab., Chilton (UK). Dec 1989. 125p. Order Number DE91623574. Source: OSTI; NTIS (US Sales Only); INIS.

Neutron inelastic scattering is used here to attempt to obtain optical spectra for lanthanide metals and compounds. Intermultiplet spectroscopy provides information about transitions from different electronic configurations and hybridisation of the 4f shell. This report discusses the relatively limited contribution that neutron scattering has played in intermultiplet spectroscopy, and covers spin-orbit transitions and coulomb transitions Racah algebra is developed in calculating the scattering cross sections. (author).

15507 (RAL–90-081) **Empirical determination of effective charges in electron impact ionisation.** Whelan, C.T. (Rutherford Appleton Lab., Chilton (UK)); Walters, H.R.J.; Dreizler, R.M. Rutherford Appleton Lab., Chilton (UK). Nov 1990. 12p. Order Number DE91623575. Source: OSTI; NTIS (US Sales Only); INIS.

The first order effective charge description of the electron impact ionisation of H(1s) is considered. The effect of imposing the Peterkop relation on the charges occuring therein is discussed. A special case corresponding to high energy asymmetric geometry is considered and values for the effective charges deduced by comparison with the most accurate available theoretical and experimental data. Empirical prescriptions are proposed for the charges and applied to several different cases. (author).

15508 (UCRL-ID–106591) **Magnetic substates populated by double electron capture in slow ion atom collisions.** Randall, K.L. Lawrence Livermore National Lab., CA (USA). 13 Dec 1990. 75p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91010122. Source: OSTI; NTIS; GPO Dep.

The work presented here is the first measurement of the angular distribution of Auger electrons following double electron capture by a beam of slow highly charged ions. From this, relative cross sections for the population of individual M_L substates were determined.

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Refer also to citation(s) 14825, 15263

15509 (CONF-9105137–2) **Monte Carlo simulation of supercritical solutions in the grand canonical ensemble.** Shah, V.M. (Tennessee Univ., Knoxville, TN (USA). Dept. of Chemical Engineering); Bienkowski, P.R.; Cochran, H.D. Oak Ridge National Lab., TN (USA). [1991]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 2. international conference on supercritical fluids; Boston, MA (USA); 20-22 May 1991. Order Number DE91009152. Source: OSTI; NTIS; GPO Dep.

Molecular simulations have been undertaken of pure, repulsive, and attractive supercritical Lennard-Jones solutions using the Monte Carlo technique in the grand canonical ensemble for the same systems and states used in a previous study by the molecular dynamics technique in the canonical ensemble. The pure supercritical fluid exhibited structure which differed somewhat between the canonical and grand canonical simulations at distances of three or four diameters from a central particle. The grand canonical simulation was shown to have chemical potential in agreement with the calculations from the equation of state and to be thermodynamically consistent. Simulations of the repulsive mixture in the grand canonical ensemble were characterized by substantial statistical scatter so that the special capabilities of the grand canonical simulation – fluctuation analysis and thermodynamic consistency testing – could not be employed. The attractive supercritical mixture studied previously was found to be within the two-phase region when studied in the grand canonical ensemble. The only previous simulation of mixtures in the grand canonical ensemble did not attempt to apply the fluctuation analysis or the thermodynamic consistency test; so, the negative results of this work are new. 8 refs., 3 figs., 4 tabs.

15510 (DOE/ER/13044–T4) **[Systems near the onset and in the well developed regimes of turbulence SRC]: Progress report, 1989.** Cornell Univ., Ithaca, NY (USA). Lab. of Atomic and Solid State Physics. [1989]. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-83ER13044. Order Number DE91010639. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses singularities in flow fields, quantum spin systems in two dimensions, and dynamics of vortex sheets. (LSP)

15511 (EGG-M–90413) **Particle-fluid two-phase flow modeling.** Trapp, J.A. (Colorado Univ., Denver, CO (USA)); Mortensen, G.A.; Ransom, V.H. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1991]. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-910414–29: International topical meeting on advances in mathematics, computation and reactor physics, Pittsburgh, PA (USA), 28 Apr - 2 may 1991). Order Number DE91010102. Source: OSTI; NTIS; GPO Dep.

The present state-of-the-art models in two-phase flow (e.g., RELAP5, TRAC, etc.) are based on the fully-averaged two-fluid concept. This paper describes a new particle-fluid model that is intermediate between the numerically intractable local instant description and the fully-averaged two-fluid model. This new model uses a Lagrangian description for the dispersed phases, bubbles and droplets, and an Eulerian description for the continuous phases, liquid and vapor. The model described in this paper is limited to dispersed bubbles in a continuous phase. Plans are to expand the model to include two dispersed phases and two continuous phases. Interaction between each dispersed phase and its surrounding continuous phase takes place through void fraction coupling as well as interface mass, momentum, and energy transfer. Fully-averaged two-fluid models use correlations for determining flow regime transitions. One motivation for this particle-fluid model is to be able to predict these flow regime transitions as well as being able to use more mechanistic models for dispersed phase coalescence, breakup, wakes, etc. Graphical results from a subcooled boiling stream-water simulation using the particle-fluid model are shown. Currently, this subcooled boiling simulation as well as air-water and liquid-vapor Freon simulations are being compared with experimental data. 8 refs., 1 fig.

15512 (LA-UR–90-3383) **A three-dimensional free-Lagrange code for multimaterial flow simulations.** Sahota, M.S.; Trease, H.E. Los Alamos National Lab., NM (USA). [1991]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910664–1: 4. ASME-JSME international symposium on liquid-solid flow, Portland, OR (USA), 23-26 Jun 1991). Order Number DE91002309. Source: OSTI; NTIS; GPO Dep.

A time-dependent, three-dimensional, compressible, multicomponent, free-Lagrange code is currently under development at the Los Alamos National Laboratory. The code uses fixed-mass particles (called mass points) surrounded by median Lagrangian cells. These mass points are free to change their nearest-neighbor connections as they follow the fluid motion, which ensures accuracy in the differencing of equations and allows us to simulate flows with extreme distortions. All variables, including velocity, are mass-point centered and time-advancement is performed using the finite-volume technique. The code conserves mass, momentum, and energy exactly, except in some pathological situations. We utilize the Voronoi connections algorithm for Delaunay tetrahedralization of the median mesh during mesh generations and mesh reconnections. The code is highly vectorized and utilizes all eight processors on a Cray YMP. Also, we have recently mapped the code to the massively parallel Connection Machine. Some of the applications for the free-Lagrange method include atomspheric and ocean-circulation models, oil-reservoir and high-velocity impact simulations. These applications are in addition to our standard model problems of high-explosive driven shock-wave problems that involve high degree of deformation, shear flow, and turbulent mixing. 9 refs., 12 figs.

15513 (LA-UR–91-0911) **Hybrid codes: Methods and applications.** Winske, D. (Los Alamos National Lab., NM (USA)); Omidi, N. Los Alamos National Lab., NM (USA). [1991]. 74p. Sponsored by USDOE, Washington, DC (USA); National Aeronautics and Space Administration, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9104109–3: 4. international school for space simulation, Nara (Japan), 1-5 Apr 1991). Order Number DE91009959. Source: OSTI; NTIS; GPO Dep.

In this chapter we discuss "hybrid" algorithms used in the study of low frequency electromagnetic phenomena, where one or more ion species are treated kinetically via standard PIC methods used in particle codes and the electrons are treated as a single charge neutralizing massless fluid. Other types of hybrid models are possible, as discussed in Winske and Quest, but hybrid codes with particle ions and massless fluid electrons have become the most common for simulating space plasma physics phenomena in the last decade, as we discuss in this paper.

15514 (LA-UR–91-958) **Lattice gas simulations of one and two-phase fluid flows using the Connection Machine-2.** Chen, S. (Los Alamos National Lab., NM (USA)); Doolen, G.D.; Eggert, K.; Grunau, D.; Loh, E.Y. Los Alamos National Lab., NM (USA). [1990]. 18p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA); National Aeronautics and Space Administration, Washington, DC (USA). DOE Contract W-7405-ENG-36. Grant DPP8850;Grant NAGW1648. (CONF-9009362–1: Discrete models of fluid dynamics conference, Coimbra (Portugal), Sep 1990). Order Number DE91009962. Source: OSTI; NTIS; GPO Dep.

In this paper, we report recent lattice gas simulations for single-phase and two-phase flows for two dimensional problems using the Connection Machine-2. For the single-phase fluid problem, we use the standard 7-bit lattice gas model with the maximum collision rules. The velocity and vorticity field of the Kelvin-Helmholtz instability is studied. It is shown that the lattice gas method preserves

the main properties of the flow patterns observed in other numerical simulations. Using colored particles and holes, the lattice gas method is extended to simulate immiscible fluids with adjustable surface tension, using a purely local collision scheme. The locality of this model allows us to implement a very fast and parallel algorithm on the Connection Machine-2. Because this new model correctly describes short-range particle-particle interactions between liquids and also particle-solid interactions between the fluid and the wall, cohesion and wettability can be simulated. Applications of the current model to several physical systems including spinodal decomposition, Rayleigh-Taylor flows and wettability in two-phase flows through porous media are discussed. 15 refs., 10 figs.

15515 (SAND–90-1850C) **Developing natural convection in a fluid layer with localized heating and large viscosity variation.** Hickox, C.E.; Chu, Tze Yao. Sandia National Labs., Albuquerque, NM (USA). [1991]. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910684–2: 1. ASME/JSME fluids engineering conference, Portland, OR (USA), 23-26 Jun 1991). Order Number DE91005240. Source: OSTI; NTIS; GPO Dep.

Numerical simulations and laboratory experiments are used to elucidate aspects of transient natural convection in a magma chamber. The magma chamber is modeled as a horizontal fluid layer confined within an enclosure of square planform and heated from below by a strip heater centered on the lower boundary of the enclosure. The width of the strip heater and the depth of the fluid layer are one-fourth of the layer width. Corn syrup is used as the working fluid in order to approximate the large viscosity variation with temperature and the large Prandtl number typical of magma. The quiescent, uniform, fluid layer is subjected to instantaneous heating from the strip heater producing a transient flow which is dominated by two counter-rotating convective cells. Experimentally determined characteristics of the developing flow are compared with numerical simulations carried out with a finite element computer program. The results of numerical simulations are in essential agreement with experimental data. Differences between the numerical simulations and experimental measurements are conjectured to result from non-ideal effects present in the experiment which are difficult to represent accurately in a numerical simulation.

15516 (SAND–90-2541C) **Measurements of passive-scalar spectra for grid turbulence using a nonlinear optical technique.** O'Hern, T.J. (Sandia National Labs., Albuquerque, NM (USA)); Torczynski, J.R.; Neal, D.R.; Shagam, R.N.; Robey, H.F. Sandia National Labs., Albuquerque, NM (USA). [1991]. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910684–1: 1. ASME/JSME fluids engineering conference, Portland, OR (USA), 23-26 Jun 1991). Order Number DE91005310. Source: OSTI; NTIS; GPO Dep.

A nonlinear optical technique has been applied to grid turbulence measurements. A laser beam passing through a turbulent region acquires phase perturbations related to the density perturbations it encounters. If the laser beam is then passed through a crystal of barium titanate ($BaTiO_3$), a photorefractive nonlinear optical material, the small-amplitude perturbations to the beam are passed but the large-amplitude unperturbed portion of the beam is deflected away from the beam path. An optical Fourier transform of the perturbations performed by a lens yields the two-dimensional density-perturbation (passive-scalar) spectrum at the lens focal plane or, alternatively, a photorefractive schlieren photograph at the lens image plane. As a test application for this technique, a system was assembled to study the downstream evolution of the density-perturbation spectrum in grid turbulence produced by an electrically heated screen spanning the test section of a wind tunnel. Near the screen, the spectrum is found to consist primarily of large-amplitude peaks at the fundamental and the first few harmonics of the screen-wake spatial frequency. As expected, these amplitudes are observed to decay rapidly in the downstream direction. 8 refs., 12 figs.

15517 (SAND–90-3227C) **Benchmarking numerical predictions with force and moment measurements on slender, supercavitating bodies.** Hailey, C.E.; Clark, E.L.; Cole, J.K. Sandia National Labs., Albuquerque, NM (USA). [1991]. 18p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9106114–1: 1991 cavitation and multiphase flow conference, Portland, OR (USA), 23-26 Jun 1991). Order Number DE91007066. Source: OSTI; NTIS; GPO Dep.

High-speed water-entry is a very complex, dynamic process. As a first attempt at modeling the process, a numerical solution was developed at Sandia National Laboratories for predicting the forces and moments acting on a body with a steady supercavity, that is, a cavity which extends beyond the base of the body. The solution is limited to supercavities on slender, axisymmetric bodies at small angles of attack. Limited data were available with which to benchmark the axial force predictions at zero angle of attack. Even less data were available with which to benchmark the pitching moment and normal force predictions at nonzero angles of attack. A water tunnel test was conducted to obtain force and moment data on a slender shape. This test produced limited data because of waterproofing problems with the balance. A new balance was designed and a second water tunnel test was conducted at Tracor Hydronautics, Inc. This paper describes the numerical solution, the experimental equipment and test procedures, and the results of the second test. 8 refs., 11 figs.

15518 (UCRL-ID–106618) **A numerical model of particulate transport.** Cloutman, L.D. Lawrence Livermore National Lab., CA (USA). Mar 1991. 26p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91010120. Source: OSTI; NTIS; GPO Dep.

The transport of particulate matter occurs in a variety of physical systems. We describe a statistical model of particulate transport that can be used to simulate these systems. The physical particles are represented by a set of computational packets of particles. The initial particle size, velocity, and location for each packet is chosen by randomly sampling size, velocity, and source region distributions. The dynamics of the individual packets are calculated in detail by integrating their equations of motion, including momentum and energy exchange with the fluid. Numerical examples are provided. 16 refs., 11 figs., 1 tab.

15519 (UCRL-JC–105182) **Hairpin vortices, singularities, and transition to turbulence in three-dimensional shear flows.** Marcus, D.L.; Bell, J.B. Lawrence Livermore National Lab., CA (USA). Oct 1990. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910651–1: 10. AIAA computational fluid dynamics conference in conjunction with the 22nd AIAA fluid dynamics, plasma dynamics and lasers conference and the 26th AIIA thermophysics conference, Honolulu, HI (USA), 24-26 Jun 1991). Order Number DE91002792. Source: OSTI; NTIS; GPO Dep.

We study the evolution of a transversely perturbed co-flowing jet in a triply periodic box by means of a second-order projection method for the three-dimensional Euler equations. Advection-diffusion equations are solved without enforcing the incompressibility constraint, and the resulting velocity field is projected onto a divergence-free subspace. The method is unique in its treatment of nonlinear advection; it incorporates a second-order, upstream-centered differencing procedure that provides a robust treatment of nonsmooth data without introducing spurious oscillations, even in the limit of vanishing viscosity. The flow is visualized by following the evolution of a tracer function initialized on the surface of the tube. We also carry out a volume rendering of the vorticity field with an opacity profile and color map which shows that hairpin vortices abound and that vorticity intensifies greatly at their tips. We present strong numerical evidence that the vorticity becomes unbounded, and show that accompanying the onset of the singularity is a decay in the mean kinetic energy. Following the onset, a Kolmogorov ($k^{-5/3}$) range emerges in the energy spectrum.

15520 (UCRL-JC–105183) **Numerical simulation of a viscous vortex ring interaction with a density interface.** Marcus, D.L.; Bell, J.B. Lawrence Livermore National Lab., CA (USA). Oct 1990. 18p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910651–2: 10. AIAA computational fluid dynamics conference in conjunction with the 22nd AIAA fluid dynamics,

plasma dynamics and lasers conference and the 26th AIIA thermophysics conference, Honolulu, HI (USA), 24-26 Jun 1991). Order Number DE91002790. Source: OSTI; NTIS; GPO Dep.

When a vortex-dominated flow interacts with a sharp density interface, the dynamics are characterized by the interaction of baroclinically generated vorticity with the already existing vorticity field. This can be seen in many natural and technology settings; examples are the interaction of a ship or submarine wake with a thermocline, the collision of a buoyant thermal with a temperature inversion, and the interaction of a vortex flow with a flame front. This problem also serves as a generic model for turbulent mixing and entrainment processes across sharp density interfaces. The interaction between vortices and a free surface, with corresponds to the case where the density jump is very large, has been studied fairly extensively, both experimentally and computationally. By comparison, the literature for the more general case of vortex pairs and rings interacting with sharp density interfaces is relatively sparse. Experiments and numerical studies have been performed, but the numerical simulations were confined primarily to vortex pairs, restricted to the inviscid case, and the effect of density variation modeled under the Boussinesq approximation. The experiments were also confined to the Boussinesq regime. In this paper, we study the motion of a vortex ring in a sharply stratified, viscous fluid via a numerical solution of the full Navier-Stokes equations with finite-amplitude density variation. both Boussinesq and non-Boussinesq flow regimes will be studied, the effect of viscosity on the interaction will be examined, and three-dimensional aspects of the motion will be addressed, such as Widnall instability of the vortex ring and vortex reconnection at the interface.

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15521 (DOE/ER/40371–4) **Intermediate/high energy nuclear physics.** Iowa State Univ. of Science and Technology, Ames, IA (USA). [1991]. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-87ER40371. Order Number DE91010702. Source: OSTI; NTIS; INIS; GPO Dep.

This progress report discusses: the quark cluster model; solving quantum field theories in non-perturbative regime; relativistic wave equations, quarkonia and e^+e^- resonances; thermal properties of nuclei; and relativistic heavy ions and other projects. (LSP)

15522 (LBL–90-Rev.-11/90) **A guide to experimental elementary particle physics literature, 1985–1989: Revision.** Alekhin, S.I. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij); Bazeeva, V.V.; Ezhela, V.V.; Filimonov, B.B.; Lugovsky, S.B.; Nikolaev, A.S.; Petrova, N.L.; Slabospitsky, S.R.; Striganov, SLawrence Berkeley Lab., CA (USA). Nov 1990. 400p. Sponsored by USDOE, Washington, DC (USA); National Science Foundation, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010209. Source: OSTI; NTIS; INIS; GPO Dep.

We present an indexed guide to experimental high energy physics literature for the years 1985–1989. No actual data are given, but approximately 3500 papers are indexed by Beam/Target/Momentum, Reaction/Momentum (including the final stare), Final State Particle, and Accelerator/Experiment/Detector.

6451 Particle Interactions and Properties - Experimental

Refer also to citation(s) 15153, 15504, 15652, 15681, 15690, 15758

15523 (ANL-HEP-CP–91-03) **Recent results and future prospects for the polarized beam at Fermilab.** Yokosawa, A. E-704 Collaboration. Argonne National Lab., IL (USA). [1990]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-9011177–7: Polarized collider workshop, University Park, PA (USA), 15-17 Nov 1990). Order Number DE91010590. Source: OSTI; NTIS; INIS; GPO Dep.

We summarize activities concerning the Fermilab polarized beams. They include a brief description of the polarized-beam facility, measurements of beam polarization by polarimeters, asymmetry measurements in the π^0 production at high $p_\perp$ and in the Λ (Σ^0), $\pi^\pm$, π^0 production at large x_F, and $\Delta\sigma_L(pp, \bar{p}p)$ measurements (Fermilab E-704). In the future we plan to investigate the proton-spin crisis by determining the gluon spin distribution in inclusive production of direct gamma, $\chi 2$, and J/ψ. 20 refs., 5 figs.

15524 (BNL–45844) **Partial wave analysis of $K\bar{K}\pi$ from $\bar{p}p \rightarrow K^+\bar{K}^0\pi^-X$ at 8 GeV/c.** Boehnlein, A. (Florida State Univ., Tallahassee, FL (USA)); Boehnlein, D.; Goldman, J.H.; Hagopian, V.; Chung, S.U.; Fernow, R.; Kirk, H.; Protopopescu, S.D.; Willutzki, H.J.; Blessing, S.; Crittenden, R.; Dzierba, A.; Zieminska, D.; Clement, B.J.; KrishnaBrookhaven National Lab., Upton, NY (USA). [1990]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-9009309–11: Rheinfels workshop on hadron mass spectrum, St. Goar (Germany, F.R.), 3-6 Sep 1990). Order Number DE91009450. Source: OSTI; NTIS; INIS; GPO Dep.

We present the results of an amplitude analysis of the spin parity components as a function of mass of the $(K^+\bar{K}^0\pi^-)$ system as produced in the reaction $\bar{p}p \rightarrow (K^+\bar{K}^0\pi^-)$ X. Two peaks are observed in the $(K^-\bar{K}^0\pi^-)$ spectrum, one at (1279 ± 2) MeV/c^2 with a width of (21 ± 2) MeV/c^2, and one at (1417 ± 3) MeV/c^2 with a width of (62 ± 5) MeV/c^2. The amplitude analysis was performed in sixteen 20 MeV/c^2 mass intervals from 1.24 to 1.56 GeV/c^2. The waves used for the fitting were $J^{PG} = 0^{-+}$, 1^{++}, 1^{+-}, and background. 12 refs., 8 figs.

15525 (BONN-IR–90-47) **Separation of minimum and higher twist in the photoproduction of mesons with large transverse momenta.** Hoeger, K.C. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Oct 1990. 72p. (In German). Order Number DE91764651. Source: OSTI; NTIS (US Sales Only); INIS.

Higher-twist effects in point-like photon interactions on hydrogen have been studied in xF-distributions of charged particles for $-0.2 < xF < 0.84$ and $pT > 2.0$ GeV/c. Data were taken with a tagged photon beam with energies between 70 and 170 GeV and a pion/kaon beam at fixed energies of 80 and 140 GeV using the same setup of detectors at the CERN-Ω-spectrometer (WA69 experiment). The pion and kaon interactions were used to obtain an estimate of the hadron-like photon component. A first estimation of Higher-Twist cross sections in photoproduction of mesons at high pT has been obtained that is consistent with QCD-expectations. (orig.).

15526 (CERN–90-10(v.1)) **Large hadron collider workshop. Proceedings. Vol. 1.** Jarlskog, G.; Rein, D. (eds.). European Organization for Nuclear Research, Geneva (Switzerland); European Committee for Future Accelerators. 3 Dec 1990. 632p. (CONF-9010291–: Large Hadron Collider (LHC) workshop: physics and instrumentation, Aachen (Germany, F.R.), 4-9 Oct 1990; ECFA–90-133(v.1).). Order Number DE91623943. Source: OSTI; NTIS (US Sales Only); INIS.

The aim of the LCH workshop at Aachen was to discuss the 'discovery potential' of a high-luminosity hadron collider (the Large Hadron Collider) and to define the requirements of the detectors. Of central interest was whether a Higgs particle with mass below 1 TeV could be seen using detectors potentially available within a few years from now. Other topics included supersymmetry, heavy quarks, excited gauge bosons, and exotica in proton-proton collisions, as well as physics to be observed in electron-proton and heavy-ion collisions. A large part of the workshop was devoted to the discussion of instrumental and detector concepts, including simulation, signal processing, data acquisition, tracking, calorimetry, lepton identification and radiation hardness. The workshop began with parallel sessions of working groups on physics and instrumentation and continued, in the second half, with plenary talks giving overviews of the LHC project and the SSC, RHIC, and HERA programmes, summaries of the working groups, presentations from industry, and conclusions. Vol. 1 of these proceedings contains the papers presented at the plenary sessions, Vol. 2 the individual contributions to the physics sessions, and Vol. 3 those to the instrumentation sessions. (orig.).

15527 (DESY–90-117) **Two-photon production of $\eta\pi\pi$ final states.** Karch, K.H. Deutsches Elektronen-Synchrotron (DESY),

Hamburg (Germany, F.R.). Oct 1990. 6p. (CONF-9009309--: Rheinfels workshop on hadron mass spectrum, St. Goar (Germany, F.R.), 3-6 Sep 1990). Order Number DE91764663. Source: OSTI; NTIS (US Sales Only); INIS.

Recent results from the Crystal Ball and CELLO experiments are presented. Evidence for the observation of a new $\eta\pi\pi$ resonance with a mass of about 1900 MeV/c^2 is reported. (orig.).

15528 (DESY-90-121) **Reconstruction of semileptonic b → u decays.** Albrecht, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Ehrlichmann, H.; Glaeser, R.; Harder, G.; Krueger, A.; Nau, A.; Nilsson, A.W.; Nippe, A.; Oest, T.; Reidenbach, M.; Schaefer, M.; Schmidt-Parzefall, W.; Schroeder, H.; Schulz,ARGUS Collaboration. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Oct 1990. 16p. Contract BMFT 054DO51P;BMFT 054ER12P;BMFT 054HD24P;BMFT 054KA17P Order Number DE91764662. Source: OSTI; NTIS (US Sales Only); INIS.

Using the ARGUS detector at the e^+e^- storage ring DORIS II at DESY we have updated our results on charmless semileptonic B decays and searched for direct evidence for b → u transitions through reconstruction of complete events. This approach has successfully identified two $\Upsilon(4S)$ events which contain B meson decays toa non-charm final state. In one case, a B^0 meson is found in the channel $\pi^+ \mu^-$anti ν, while in the other a decay $B^+ \to \omega\mu^+\nu$ is seen. These events show that the previously observed signal of charmless semileptonic B decays is due to b → u transitions from which we obtain vertical strokeV_{ub}/V_{cb}vertical stroke = 0.11 ± 0.012 using the model of Altarelli et al. (orig.).

15529 (DESY-90-128) **Some snapshots of new CELLO and Crystal Ball results on $\gamma\gamma$ reactions.** Feindt, M. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Oct 1990. 4p. Contract BMFT 054HH23P/7. (CONF-900822--: 25. IUPAP international conference on high energy physics, Singapore (Singapore), 2-8 Aug 1990). Order Number DE91764657. Source: OSTI; NTIS (US Sales Only); INIS.

Two topics from recent experimental two-photon spectroscopy are presented which are of relevance even in the LEP era - the discovery of a new (probably 2^{-+}) resonance in $\gamma\gamma \to \eta\pi\pi$ by Crystal Ball and CELLO, and the measurements of the electromagnetic form factors of the π^0, η and η' by CELLO. (orig.).

15530 (DESY-90-138) **Observation of the decays $D_s^- \to \phi e^-$anti ν and $D^- \to K^{*0}e^-$anti ν.** Albrecht, H. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Ehrlichmann, H.; Hamacher, T.; Krueger, A.; Mundt, R.; Nau, A.; Nippe, A.; Oest, T.; Reidenbach, M.; Schaefer, M.; Schmidt-Parzefall, W.; Schroeder, H.; Schulz, H.D.; Sefkow,.ARGUS Collaboration. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Nov 1990. 8p. Contract BMFT 054DO51P;BMFT 054ER12P;BMFT 054HD24P;BMFT 054KA17P Order Number DE91764654. Source: OSTI; NTIS (US Sales Only); INIS.

Using the ARGUS detector at the e^+e^- storage ring DORIS II at DESY, we have studied semileptonic charmed meson decays through Φ and K^{*0}-electron correlations in continuum production. Evidence for the decay $D_s^- \to \Phi e^-$anti ν has been observed, with a branching ratio relative to the channel $D_s^- \to \Phi\pi^-$ determined to be 0.57 ± 0.15 ± 0.15. The decay $D^- \to K^{*0}e^-$anti ν was also seen, with a value of 0.55 ± 0.08 ± 0.10 extracted for the branching ratio relative to the channel $D^- \to K^+\pi^-\pi^-$. The ratio of the two measurements, after application of SU(3) corrections, implies a branching ratio for $D_s^- \to \Phi\pi^-$ of (2.4 ± 1.0)%. (orig.).

15531 (DESY-90-149) **A search for substructure of leptons and quarks with the CELLO detector.** Behrend, H.J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Criegee, L.; Field, J.H.; Franke, G.; Jung, H.; Meyer, J.; Podobrin, O.; Schroeder, V.; Winter, G.G.; Bussey, P.J.; Buttar, C.; Campbell, A.J.; Hendry, D.; Lumsdon, S.; SkillCELLO Collaboration. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Nov 1990. 27p. Order Number DE91768989. Source: OSTI; NTIS (US Sales Only); INIS.

Differential cross section data of the CELLO experiment on pair production of muons, taus, and heavy quarks in e^+e^--annihilation are presented and analysed, together with our data on Bhabha scattering, in terms of compositeness effects characterized by the mass scale Λ. We discuss difficulties in the combination of limits Λ from different experiments. The appropriate parameter to combine different results turns out to be $\epsilon = +\text{-}1/\Lambda^2$, which has in contrast to Λ Gaussian distributed errors. (orig.).

15532 (DOE/ER/03072-64) **A search for the rare decay $K^+ \to \pi^+ \nu\bar{\nu}$.** Akerib, D.S. Princeton Univ., NJ (USA). Dept. of Physics. Jan 1991. 134p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76ER03072. Order Number DE91010354. Source: OSTI; NTIS; INIS; GPO Dep.

This thesis describes an experimental search for the weak decay $K^+ \to \pi^+\nu\bar{\nu}$ performed at Brookhaven National Laboratory during the Winter of 1989 using the E787 Spectrometer designed expressly for this purpose. The first-order contribution to this decay cancels exactly via the Glashow-Iliopoulos-Maiani (GIM) Mechanism. However, the second-order process is expected to give a branching ratio between .6 → 6 × 10^{-10} in the Standard Model. The predicted rate for this process is theoretically well determined; the uncertainty is due to the experimental input parameters of the Model. We find no candidate events in a sample of 1.12 × 10^{11} kaon decays and we set an upper limit on the branching ratio of 4.4 × 10^{-9} at the 90% confidence level. Using the same data we also set an upper limit on the process $K^+ \to \pi^+$f of 9.3 × 10^{-10} at the 90% confidence level, where f is any neutral massless weakly-interacting particle.

15533 (DOE/ER/40368-T1) **[Studies of high energy phenomena using muons]: Progress report.** Northern Illinois Univ., De Kalb, IL (USA). [1990]. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-87ER40368. Order Number DE91010397. Source: OSTI; NTIS; INIS; GPO Dep.

This report covers the activities of the NIU high energy physics group as supported by DOE contract AC02-87ER40368 during the period from March through December of 1990. Our group has two primary efforts. The first is the D0 experiment at the Fermilab proton-antiproton collider, with major emphasis on its muon system. The second is the involvement of a portion of the group in Fermilab Experiments 772 and 789. Finally, we are also participating in the design of detectors for the SSC. A more detailed description of the work of the NIU high energy physics group may be found in the narrative accompanying our contract renewal proposal.

15534 (DOE/ER/40419-22) **Selected problems in experimental intermediate energy physics: Progress report, February 1, 1990-January 31, 1991.** Mayes, B.W.; Hungerford, E.V.; Pinsky, L.S. Texas Univ., Houston, TX (USA). Dept. of Physics. Sep 1990. 62p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-88ER40419. Order Number DE91008910. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses progress in the following areas of intermediate energy physics; hyperon physics at the AGS; electroproduction of hypernuclei; test of the standard model of electroweak interactions; and spin structure function of the neutron. (LSP)

15535 (DOE/ER/40479-3) **The Sudbury Neutrino Observatory project and the Kamiokande II project: Technical progress report, July 1, 1990-June 30, 1991.** Beier, E.W. Pennsylvania Univ., Philadelphia, PA (USA). Dept. of Physics. 4 Mar 1991. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-88ER40479. Order Number DE91010641. Source: OSTI; NTIS; INIS; GPO Dep.

This document is a technical progress report on work performed at the University of Pennsylvania during the current year on the Sudbury Neutrino Observatory project and on the Kamiokande II project. The motivation for both experiments is the measurement of neutrinos emitted by the sun. The Kamiokande II experiment was an adaptation of an existing nucleon decay detector located in Japan to search for neutrinos emitted by the sun. It has been operational since 1986. Data taking was concluded in 1990 and work will terminate at the end of this grant year. The topics discussed in this report are: the Sudbury Neutrino Observatory project; photomultiplier tube measurements; photomultiplier bases; signal processing electronics; electronics system issues; software management and development; and Kamiokande II.

15536 (DOE/ER/40523–T3) **Experimental study of heavy flavor physics and SSC research and development at the University of Mississippi: Progress report, July 1, 1989–March 1, 1990.** Reidy, J.J. Mississippi Univ., University, MS (USA). Dept. of Physics and Astronomy. [1991]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AS05-89ER40523. Order Number DE91010747. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses research in particle production and decay of charmed particles. The detectors used are discussed as well as data acquisition system. Research on superconducting super collider is also discussed. (LSP)

15537 (DOE/ER/40526–1) **[Study of hyperons and beauty particles]: Progress report.** California Univ., Berkeley, CA (USA). [1991]. 3p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG03-89ER40526. Order Number DE91010258. Source: OSTI; NTIS; INIS; GPO Dep.

The proposed research program is to study the production and decay properties of the hyperons and the beauty hadrons at Fermilab. Since the project was approved in 1989, a lot of progress has been made. This report is a summary of the achievements.

15538 (FNAL/C–90/255-E) **B-physics at CDF.** Baden, A.R. (Harvard Univ., Cambridge, MA (USA)). The CDF collaboration. Fermi National Accelerator Lab., Batavia, IL (USA). 10 Dec 1990. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. (CONF-900799–5: 18. SLAC summer institute on particle physics: heavy quarks and gauge bosons, Stanford, CA (USA), 16-27 Jul 1990). Order Number DE91010308. Source: OSTI; NTIS; INIS; GPO Dep.

During the 1988/1989 run at the Fermilab Tevatron, the CDF detector collected $\simeq$4.1 pb^{-1} of $p\bar{p}$ data at $\sqrt{s}$ = 1.8 TeV. The main goals of this run being physics at high p_t, the CDF trigger was "tuned" for maximizing signals from Z^0s, Ws, t-quarks, etc. As such, compared to the high p_t physics, the b-physics program was of secondary importance other than that which would be used for background calculations. Also, CDF had no vertex chamber capability for seeing displaced vertices. However, significant b-quark, physics results are evident in two data samples; inclusive electrons and inclusive J/ψ where $J/\psi \rightarrow \mu^+\mu^-$. We can then ask ourselves, given all this, why is it that CDF is able to do b-quark physics? The answer is that nature has been kind enough to provide b-quarks at an extremely high rate at the Tevatron. The production cross-section for $b\bar{b}$ production is quite large. In the rest of this paper, I will try to specify the goals for b-physics using the inclusive electrons and J/ψ signals for the 1988/1989 data set. I will then provide a brief look at the data, and will finish with some highly speculative guesses as to whether or not experiments at the Tevatron which look for CP violation in the b sector are possible.

15539 (FNAL/C–91/66-E) **Search for the top quark with CDF.** Barbaro-Galtieri, A. (Lawrence Berkeley Lab., CA (USA)). E-741 CDF collaboration. Fermi National Accelerator Lab., Batavia, IL (USA). 22 Jan 1991. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. (CONF-9006267–29: 1990 DPF summer study on high energy physics, Snowmass, CO (USA), 25 Jun - 13 jul 1990). Order Number DE91010309. Source: OSTI; NTIS; INIS; GPO Dep.

During the 1988–89 Tevatron Collider run the CDF detector has collected data for an integrated luminosity of 4.4 pb^{-1}. The sample has been used to search for the top quark in several topologies. Preliminary results show that a top mass below 89 GeV is excluded at the 95% confidence level, thus extending the limit of 77 GeV previously published by CDF. 14 refs., 8 figs.

15540 (FNAL/C–91/81-A) **A proposed search for dark-matter axions in the 0.6–16 μeV range.** van Bibber, K. (Lawrence Livermore National Lab., CA (USA)); Sikivie, P.; Sullivan, N.S.; Tanner, D.B.; Turner, M.S.; Moltz, D.M. Fermi National Accelerator Lab., Batavia, IL (USA). Mar 1991. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48 ;FG05-86ER40272 ;FG02-90ER40560. (CONF-901141–4: International conference on trends in astroparticle physics, Santa Monica, CA (USA), 26 Nov - 1 dec 1990). Order Number DE91010353. Source: OSTI; NTIS; INIS; GPO Dep.

A proposed experiment is described to search for dark-matter axions in the mass range 0.6–16 μeV. The method is based on the Primakoff conversion of axions into monochromatic microwave photons inside a tunable microwave cavity in a large volume high field magnet, as described by Sikivie. This proposal capitalizes on the availability of two Axicell magnets from the decommissioned MFTF-B fusion machine at LLNL. Assuming a local dark-matter density in axions of ρ = 0.3 GeV/cm^3, the axion would be found or ruled out at the 97% c.l. in the above mass range in 48 months. 13 refs., 6 figs., 2 tabs.

15541 (IAE–4818-2) **Experiments proposed on low-energy ν-tilde$_e$ physics at pik-type research reactors.** Mikaelyan, L.A.; Tolokonnikov, S.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 9p. Order Number DE91623931. Source: OSTI; NTIS (US Sales Only); INIS.

It is noted that the interaction of electron antineutrinos with neutrons, protons and electrons is known with a low accuracy and the theory of electroweak interactions in this area has no quantitative verification. It is proposed to create an intensive source of hard ν-tilde$_e$ from the decay of lithium-8 on the basic of the PIK-type research reactor. Expected count rates and spectra of products of different reactions are presented. The proposed ν-tilde$_e$ source displays appreciable advantages over power and industrial reactors, on which the neutrino experiments are performed at present. 8 refs.; 5 figs.; 2 tabs.

15542 (IAE–4844-2) **On the project of measuring the neutron lifetime (τ_n) within an error of $\delta\tau_n \simeq \pm 3$s in the experiment on cold neutron beam transport in the field-free space.** Spivak, P.E. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 23p. Order Number DE91623944. Source: OSTI; NTIS (US Sales Only); INIS.

A possibility is shown for measuring the neutron lifetime (τ_n) within an error of $\pm$3s in the cold neutron beam experiment. Methods for measuring the quantities determining neutron density (Q_s), efficiency (ϵ) of observation of neutron decay events, permeability (η) of grids and counting rates (n_p) of recoiling protons were approved earlier. The errors in measurements of these quantities in the cold neutron beam experiment (on example of the ILL reactor beam) have been analyzed, and it has been found that their contribution to the τ_n error are $\delta Q_s = \pm 0.22\%$, $\delta\epsilon = \pm 0.1\%$, $\delta\eta = \pm 0.08\%$, $\delta n_p = \pm 0.14\%$ respectively. 15 refs.; 4 figs.; 1 tab.

15543 (IFVE-OEF–89-54) **Exotic hadrons.** Landsberg, L.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 84p. Order Number DE91623945. Source: OSTI; NTIS (US Sales Only); INIS.

Extended version of the Invited Talk at the XXXIV Recontres de Moriond Les Arcs, Savoie, France, March, 12-18, 1989.

Status of search and study of exotic mesonic states in hadronic reactions, J/Ψ decays and $\gamma\gamma$ collisions is presented. In the recent years these experiments resulted in the observation of several mesonic states, whose properties go beyond the framework of a simple quark model of ordinary (qantiq)-mesons. The status of the E/iota puzzles and the nature of E(1420) meson are being discussed. 91 refs.; 27 figs.; 9 tabs.

15544 (INS–813) **A search for charged Higgs bosons at TRISTAN.** Adachi, I. (Nagoya Univ. (Japan). Dept. of Physics); Aihara, H.; Moser, M. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. May 1990. 16p. Order Number DE91767869. Source: OSTI; NTIS (US Sales Only); INIS.

We searched for pair production of charged Higgs bosons via e^+e^- annihilation, using data (23.3pb^{-1}) collected by the TOPAZ detector in the energy range $\sqrt{s}$ = 52.0 $\sim$ 61.4GeV. We observed no evidence for charged Higgs pair production and extended the excluded region in the M_{H^+}–BR(hadron) plane. The 95 % CL lower mass limit is the most stringent for BR(hadron) = 0.6, giving $M_{H^+} > 22$ GeV. (author).

15545 (INS–862) **π^0-Factory using TARNII accelerator.** Ukai, Kumataro. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear

Study. Dec 1990. 18p. Order Number DE91767971. Source: OSTI; NTIS (US Sales Only); INIS.

We propose a π^0-Factory at the TARNII accelerator. The momentum spread of beam in the TARNII is cooled down to $\sim 10^{-4}$ and also a beam size at the interaction point is very small. Using this beam and an iced deuteron pellet target, we can get a high luminosity greater than $5x10^{33}$ $cm^{-2}s^{-1}$. π^0-meson is generated by the pd->$^3H_e\pi^0$ process. The interaction area is expected to be order of mm and ^3H_e, is detected very easily and clearly by the dE/dX and the TOF methods. Then, we can get a very clean π^0. These clean and luminous π^0 make possible to perform an accurate measurement for the π^0-rare decay with 2 or 3 order higher statistics than existing experiments. (author).

15546 (ITEF–131-89) **On possible existence of exotic baryon resonance in P3Π⁺Π⁻ system.** Brovkin, L.Yu. (and others); Kiselevich, I.L.; Mikhajlichenko, V.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 12p. (In Russian). Order Number DE91623946. Source: OSTI; NTIS (US Sales Only); INIS.

Preliminary results of investigation into P3Π⁺Π⁻system in $\Pi^+p \rightarrow P3\Pi^+2\Pi^-$ reaction are presented. Peak with 2480±10MeV/c mass is observed in mass spectrum of P3Π⁺Π⁻ system at certain samplings. The observed peak may be interpreted as exotic baryon. It is shown that observed baryon is born in quasi two-particle reaction. Evaluation of cross section of observed baryon production is equal to 23±8μb. 15 refs.; 9 figs.

15547 (LAL–8969) **Search for magnetic monopoles with Frejus detector.** Benadjal, Y. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire; Montpellier-2 Univ., 34 (France). Oct 1989. 162p. (In French). Order Number DE91767812. Source: OSTI; NTIS (US Sales Only).

Magnetic monopoles are predicted by every Grand Unification Theory. Their experimental search constitutes, together with proton decay, the only direct test of these theories. The Frejus experiment, using a large calorimetric detector, has looked for cosmic ray monopoles in the speed (v/c) range from 0.0001 to 0.1. No candidate was recorded. The flux limits obtained represent an original contribution at the low end of the speed range. After a first chapter covering various theoretical aspects of the monopole problem, we describe, in the following chapter, the main methods which can be applied to try to detect monopoles, and we review a certain number of experiments. The third chapter describes the Frejus magnetic monopole experiment. The detection method and the Geiger tube efficiency for slow monopoles are examined. Particular attention is given to the trigger system for slow monopoles. It was possible to add a specially designed electronic system to the detector making the monopole search possible. This system is described here. Four million events were recorded. The final chapter is devoted to their analysis. It includes, in particular, the description of the method which made it possible to reduce this mass of data to roughly 1000 events which were then scanned one by one in order to identify possible candidates. Our results in terms of flux limits are compared with those obtained by the better competing experiments.

15548 (LAL–9013) **Baryon pair production in e^+e^- annihilation at $\sqrt{s}$ = 2.4 GeV.** Bisello, D. (Padua Univ. (IT). Ist. di Fisica); Busetto, G.; Castro, A.; Nigro, M.; Pescara, L.; Posocco, M.; Sartori, P.; Stanco, L.; Antonelli, A.; Biagini, M.E.; Baldini, R.; Calcaterra, A.; Schioppa, M.; Augustin, J.E.; Cosme, G.; Couchot, F.; Fulda, FDM2 Collaboration. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. Apr 1990. 16p. Order Number DE91767806. Source: OSTI; NTIS (US Sales Only).

Search for baryon pair production in e^+e^- annihilation at $\sqrt{s}$ = 2386 MeV is reported. The data relate to a luminosity of 161 nb^{-1} collected by the DM2 experiment at DCI, the Orsay colliding ring. First measurement of direct e^+e^- annihilation into ΛantiΛ and of e^+e^- -> pantip at this energy are presented. First observation of a good e^+e^- -> nantin, candidate is reported and upper limits are given for e^+e^- -> nantin, ΛantiΣ⁰ + c.c. and Σ⁰antiΣ⁰.

15549 (LAL–9014) **Study of the eta_c decays.** Bisello, D. (Padua Univ. (IT). Ist. di Fisica); Busetto, G.; Castro, A.; Gini, P.; Pescara, L.; Sartori, P.; Stanco, L.; Ajaltouni, Z.; Dekmouche, A.; Falvard, A.; Jousset, J.; Henrard, P.; Michel, B.; Montret, J.C.; Augustin, J.E.; Cosme, G.; Couchot, F.;DM2 Collaboration. Paris-11 Univ., 91 - Orsay (France). Lab. de l'Accelerateur Lineaire. May 1990. 35p. Order Number DE91767807. Source: OSTI; NTIS (US Sales Only).

The eta_c has been observed in hadronic decay modes from the 8.6 million J/PSI collected by the DM2 experiment at DCI. The eta_c mass is set to (2974.4+-1.9) MeV/c^2. Its pseudoscalar character is measured from the eta_c -> rho^0rho^0 and PHIPHI decays. The observation of the eta_c -> PHIPHI decay fixes the eta_c isospin to zero and the G-parity to be positive. An upper limit of $\Gamma_{\gamma\gamma}(eta_c)$ is set from the search for the eta_c -> $\gamma\gamma$ decay.

15550 (LA-UR–91-761) **Nuclear effects in Drell-Yan and quarkonium production in proton-nucleus collisions.** Peng, J.C. (Los Alamos National Lab., NM (USA)); Alde, D.M.; Baer, H.W.; Carey, T.A.; Garvey, G.T.; Klein, A.; Lee, C.; Leitch, M.J.; Lillberg, J.W.; McGaughey, P.L.; Mishra, C.S.; Moss, J.M.; Brown, C.N.; Cooper, W.E.; Hsiung, Y.B.; Adams, M.R.; Guo, R.;Los Alamos National Lab., NM (USA). [1990]. 17p. Sponsored by US-DOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9005233–12: 2. international conference on medium- and high-energy nuclear physics, Taipei (Taiwan), 8-18 May 1990). Order Number DE91009940. Source: OSTI; NTIS; GPO Dep.

A precise measurement of the atomic mass dependence of dimuon production induced by 800 GeV protons incident on targets of ^2H, C, Ca, Fe, and W is reported. The relative Drell-Yan yield per nucleon, $R = Y_A/Y_{2_H}$, is sensitive to modifications of the antiquark sea in nuclei. No effect is seen for the range of target-quark momentum fraction, $0.1 < x_t < 0.3$. For $x_t < 0.1$ the ratio is slightly less than unity for the heavy nuclei. These results are compared with the predictions of EMC models. A depletion of the yield per nucleon from heavy nuclei is observed for both J/ψ and ψ' production. This depletion exhibits a strong dependence of x_F and p_t. Within experimental errors the depletion is the same for the J/ψ and the ψ'. 41 refs., 6 figs.

15551 (LA-UR–91-987) **The A dependence of dilepton production.** Garvey, G.T. Los Alamos National Lab., NM (USA). [1990]. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9010183–3: European workshop on hadronic physics with electrons beyond 10 GeV, Dourdan (France), 8-12 Oct 1990). Order Number DE91009966. Source: OSTI; NTIS; INIS; GPO Dep.

The discovery in 1982, by the EMC group, that the structure function $F_2(x)$ per nucleon is different in iron than deuterium was the first evidence that the structure of the nucleon might be altered in nuclei. Much more extensive and precise and data have been taken since the original discovery. This body of data is now quite consistent and many of the features of the original "EMC effect" remain intact. There have been a variety of theoretical explanations of the data, but none are totally compelling. The deep-inelastic-scattering (DIS) data for the ratio of $F_2^{Fe}(x)$ in iron to $F_2^D(x)$ in deuterium are given for the region $0.03 \leq x \leq \sim 1.0$.

15552 (LBL–30247) **Higgs detection via decays to leptons with the SDC detector.** Barnett, R.M.; Einsweiler, K.; Hinchliffe, I. Lawrence Berkeley Lab., CA (USA). Nov 1990. 36p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (SSC-SDC–90-00099). Order Number DE91010238. Source: OSTI; NTIS; INIS; GPO Dep.

This document discusses the potential for the SDC detector to discover the Standard Model Higgs boson via it decays to 4 charged leptons or to 2 charged leptons and 2 neutrinos. 22 refs., 22 figs.

15553 (NIIYaF-MGU–89-56-133) **Space-time structure of hadron interaction: Fixed-target experiment at p, pi and K beams with energy of 10-20 GeV.** Bel'zer, L.I.; Bodyagin, V.A.; Gribushin, A.M.; Vardanyan, I.N.; Ershov, A.A.; Sarycheva, L.I.; Sinev, N.B. Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-issledovatel'skij Inst. Yadernoj Fiziki. 1989. 8p. (In Russian). Order Number DE91623947. Source: OSTI; NTIS (US Sales Only); INIS.

Experiment with a fixed target in p, π and K beams of intermediate energies (10-20 GeV) is carried out t trace the evolution of

nonequilibrium hadron states passing through a nuclear substance in search of the most characteristic manifestations of the mechanism of quark hadronization. Differential cross sections of leading hadron generation L on nuclear targets from hydrogen to lead are measured for semiinclusive reaction $hA \rightarrow L+X_\eta$, where X_η is selection of events with certain configuration of tracks corresponding to incoherent channels with required pulse transfer from initial particle to ΔP target or interaction range $\Delta z \approx$ Planck constant/ΔP. 3 refs.; 2 figs.

15554 (NIKHEF-H–90-16) **Inclusive D^{*+-} production in photon-photon collisions.** Alston-Garnjost, M. (Lawrence Berkeley Lab., CA (USA)); Avery, R.E.; Barker, A.R. Stanford University-NIKHEF-H Collaboration; TPC/Two-Gamma Collaboration. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. Oct 1990. 15p. (SLAC-PUB–5348.). Order Number DE91623941. Source: OSTI; NTIS (US Sales Only); INIS.

The TPC/Two-Gamma Collaboration has measured the inclusive cross section for the production of charmed D^{*+-} mesons in photon-photon collisions. The reaction utilized was $e^+e^- \rightarrow e^+e^-D^{*-}X$, with $D^{*-} \rightarrow D^0\pi^{*-}$, $D^0 \rightarrow K^-\pi^{*-}$, and either zero or one outgoing e^+ detected. The result, sigma ($e^+e^- \rightarrow e^+e^-D^{*-}X$) 74+-26+-19 pb, is in agreement with the Quark Parton Model prediction for $e^+e^- \rightarrow e^+e^-c$ c-bar, combined with a Lund model for the hadronization of the charmed quarks. (author). 12 refs.; 4 figs.

15555 (ORNL/FTR–3870) **[L* collaboration meeting]: Foreign trip report, March 4–8, 1991.** Plasil, F. Oak Ridge National Lab., TN (USA). 13 Mar 1991. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91009876. Source: OSTI; NTIS; GPO Dep.

The traveler attended the L* collaboration meeting held in St. Genis, France, near CERN, Geneva. Various member countries of the collaboration presented recent R&D results. Strategy was discussed for the upcoming PAC meeting in Dallas. The traveler also held several discussions concerning CERN collaborative experiments L3 and WA93. The possibility of ORNL participation in a CERN experiment using lead beams was also discussed.

15556 (SSCL–347) **The B factory, the Superconducting Super Collider, and an e^+e^- linear collider: How they stand against each other.** Sanda, A.I. (Superconducting Super Collider Lab., Dallas, TX (USA)). Superconducting Super Collider Lab., Dallas, TX (USA). Jan 1991. 10p. Sponsored by USDOE, Washington, DC (USA); National Science Foundation, Washington, DC (USA). DOE Contract AC02-89ER40486. Contract NSF-INT-8613131. (CONF-8910393–1: Workshop for asymmetric B-factory at KEK, Tsukuba (Japan), 2-4 Oct 1989). Order Number DE91009903. Source: OSTI; NTIS; INIS; GPO Dep.

Many high energy physicists in Japan will be participating in Superconducting Super Collider (SSC) experiments. KEK is planning to build a B factory. Japan Linear Collider (JLC) — an e^+e^- linear collider with $\sqrt{s} = (.5 \sim 1.5)$ TeV — is being considered as the future project at KEK. I have been asked to discuss the physics compatibilities and the relative merits of these three projects. From a physics point of view, nobody can argue against building an accelerator. Looking back at the past 40 years, we note that physics discoveries from new accelerators often far exceeded our original expectations. In order to make accelerators cost effective, their parameters must be tuned so that there is guaranteed physics. By guaranteed physics, I mean that a machine must be capable of observing new phenomena predicted by the most conventional standard model. Discoveries beyond such bottom line expectations should be treated as bonuses and should not be treated as major motivations for building a machine. I will first discuss the bottom line physics at SSC and at a B factory. I will then go on to discuss the compatibility of the two physics. Finally, I will discuss the physics at JLC, and its relationship with that at SSC and at a B factory.

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Refer also to citation(s) 15742, 15743

15557 (ANL-HEP-TR–91/17) **Fast shower simulation based on Gauß's law.** Trost, H.J. Argonne National Lab., IL (USA). 1 Mar 1991. 36p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. Order Number DE91009885. Source: OSTI; NTIS; INIS; GPO Dep.

I have developed a procedure for fast shower simulation on the basis of Gauß's law, applied in analogy to charge distributions and related vector fields of electromagnetic interactions. The nature of a shower (i.e. electromagnetic or hadronic), a homogeneous medium for its development, its starting point, direction and energy content are needed to be specified. Then the contribution from the shower to the total signal in any given volume made up of the given medium can be calculated as an integral over the surface of that volume using a precalculated vector field corresponding to the shower distribution. Thus the integration problem is reduced from three to two dimensions. The quality of the shower simulation is determined by the accuracies of the vector fields and of the surface integration. This technique is shown to yield acceptable results for typical sized of calorimeter cell structures. 19 refs., 4 figs.

15558 (BNL–45455) **Quark screening lengths in finite temperature QCD.** Gocksch, A. (Brookhaven National Lab., Upton, NY (USA)). Brookhaven National Lab., Upton, NY (USA). Nov 1990. 5p. Sponsored by USDOE, Washington, DC (USA); National Aeronautics and Space Administration, Washington, DC (USA); National Science Foundation, Washington, DC (USA). DOE Contract AC02-76CH00016. Grant PHY89-04035. (CONF-901072–14: LATTICE '90: 7th international lattice gauge theory conference, Tallahassee, FL (USA), 8-12 Oct 1990). Order Number DE91010366. Source: OSTI; NTIS; INIS; GPO Dep.

We have computed Landau gauge quark propagators in both the confined and deconfined phase of QCD. I discuss the magnitude of the resulting screening lengths as well as aspects of chiral symmetry relevant to the quark propagator. 12 refs., 1 fig., 1 tab.

15559 (BNL–45575) **Applications of gauge-fixed correlation functions of quarks and gluons.** Bernard, C. (California Univ., Santa Barbara, CA (USA). Inst. for Theoretical Physics); Soni, A.; Yee, K. Brookhaven National Lab., Upton, NY (USA). Dec 1990. 6p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. (CONF-901072–13: LATTICE '90: 7th international lattice gauge theory conference, Tallahassee, FL (USA), 8-12 Oct 1990; NSF-ITP–90-214). Order Number DE91010365. Source: OSTI; NTIS; INIS; GPO Dep.

Two uses of fixed gauge correlation functions involving quarks and gluons – as probes of effective quark and gluon parameters and their gauge dependence and as constraints for matching coefficients – are examined. Effective quark and gluon masses are found to decrease with increasing gauge parameter λ. A fixed gauge technique is used to determine $\bar{s}d$ matching coefficients. Despite gauge variance of effective quark masses, results of this matching – modulo statistics – are gauge invariant. Accordingly this technique is applied to the Delta $I = \frac{1}{2}$ Rule. We are however unable to obtain physically useful results at present in this case because of large fluctuations. 17 refs., 5 figs.

15560 (CSNSM–8954) **Low-energy antiproton physics at Lear.** Thibault, C. Paris-11 Univ., 91 - Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse. 1990. 17p. (CONF-8909299–: 5. French-Japanese symposium on nuclear physics: new aspects and future prospects in nuclear physics at intermediate energies, Dagashima (Japan), 26-30 Sep 1989). Order Number DE91767818. Source: OSTI; NTIS (US Sales Only).

The present status of the program of low-energy antiproton physics at LEAR is presented. This program is developing according to four main lines: (1) Nucleon-Antinucleon interactions: spectroscopy of protonium and antiprotonic atoms, elastic and inelastic scattering, charge-exchange reactions, strangeness-exchange reactions, antiproton-nucleus interactions. (2) Annihilations: dynamics of nucleon-antinucleon annihilation at rest, multinucleon annihilations, meson spectroscopy, search for exotic structures, proton form factors in the time-like region, study of CP violation. (3) Comparison of p and antip properties: comparison of their inertial masses (test of CPT invariance), and of their gravitational masses. (4) Use of antip as a probe in Atomic Physics.

15561 (DESY–90-114) **Fractal dimensions from a 3-dimensional intermittency analysis in e^+e^- annihilation.** Behrend, H.J. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.)); Criegee, L.; Field, J.H.; Franke, G.; Jung, H.; Meyer, J.; Podobrin, O.; Schroeder, V.; Winter, G.G.; Bussey, P.J.; Campbell, A.J.; Hendry, D.; Lumsdon, S.J.; Skillicorn, I.OCELLO Collaboration. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Oct 1990. 13p. Order Number DE91764664. Source: OSTI; NTIS (US Sales Only); INIS.

The intermittency structure of multihadronic e^+e^- annihilation is analyzed by evaluating the factorial moments F_2-F_5 in 3-dimensional Lorentz invariant phase space as a function of the resolution scale. We interpret our data in the language of fractal objects. It turns out that the fractal dimension depends on the resolution scale in a way that can be attributed to geometrical resolution effects and dynamical effects, such as the π^0 Dalitz decay. The LUND 7.2 hadronization model provides an excellent description of the data. There is no indication of unexplained multiplicity fluctuations in small phase space regions. (orig.).

15562 (DESY–90-116) **Flux quantization and quantum mechanics on Riemann surfaces in an external magnetic field.** Bolte, J. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik); Steiner, F. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Oct 1990. 7p. Order Number DE91764665. Source: OSTI; NTIS (US Sales Only); INIS.

We investigate the possibility to apply an external constant magnetic field to a quantum mechanical system consisting of a particle moving on a compact or non-compact two-dimensional manifold of constant negative Gaussian curvature and of finite volume. For the motion on compact Riemann surfaces we find that a consistent formulation is only possible if the magnetic flux is quantized, as it is proportional to the (integrated) first Chern class of a certain complex line bundle over the manifold. In the case of non-compact surfaces of finite volume we obtain the striking result that the magnetic flux has to vanish identically due to the theorem that any holomorphic line bundle over a non-compact Riemann surface is holomorphically trivial. (orig.).

15563 (DESY–90-122) **A note on gluon distribution at small x.** Charchula, K.; Krawczyk, M. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). 19 Oct 1990. 8p. Order Number DE91764667. Source: OSTI; NTIS (US Sales Only); INIS.

We compare the small x behaviour of gluon distribution resulting from the Balitskij-Lipatov equation and from the Monte Carlo approach proposed by Marchesini and Webber. The role of the momentum conservation constraints is discussed. (orig.).

15564 (DESY–90-125) **How to determine all the angles of the unitarity triangle from $B_d^0 \to DK_S$ and $B_s^0 \to D\phi$.** Gronau, M. (Technion-Israel Inst. of Tech., Haifa (Israel)); London, D. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Oct 1990. 16p. (TECHNION-PH–90-26;UdeM-LPN-TH–34). Order Number DE91764660. Source: OSTI; NTIS (US Sales Only); INIS.

We consider within the standard model the time-dependent decay rates of the three processes $B_d^0 \to D^0$ Ks.anti D^0Ks and D_1^0Ks, where D_1^0 is a neutral D meson CP-eigenstate. We show that it is possible to derive from these processes, in which two weak amplitudes are involved, two of the three angles in the unitarity triangle of the Cabibbo-Kobayashi-Maskawa matrix. The third angle can be determined from $B_s^0 \to D\Phi$. All three angles are obtained free of hadronic final-state uncertainties. (orig.).

15565 (DESY–90-127) **Phenomenology of geometrical flavour interactions at TeV energies.** Ringwald, A.; Schrempp, F.; Wetterich, C. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Oct 1990. 31p. Order Number DE91764658. Source: OSTI; NTIS (US Sales Only); INIS.

We investigate the experimental signatures of the recently proposed 'geometrical' production of many W. Z. Higgs and (primordial) fermions ($n\omega \simeq \alpha\omega^{-1} \simeq 30$) with a relatively large cross section. Such events, if they exist, should be seen at the LHC (SSC) provided that the (parton) threshold energy for the onset of geometrical flavour production is below 11 (28) TeV. (orig.).

15566 (DESY–90-130) **Electron-state bremsstrahlung processes $ep \to \gamma ep(X)$ at HERA.** Akhundov, A.A. (AN Azerbajdzhanskoj SSR, Baku (USSR). Inst. Fiziki); Bardin, D.Yu.; Kalinovskaja, L.V. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Oct 1990. 25p. Order Number DE91764656. Source: OSTI; NTIS (US Sales Only); INIS.

The analytic formulae for the bremsstrahlung photon spectra in the processes $lN \to \gamma lN$ and $ln \to \gamma lX$ (taking into acount γ- and Z-boson exchange diagrams) are derived. The energy and angular distributions of photons are computed at HERA energies. The very large sensitivity of spectra for the deep inelastic channel to the choice of the structure functions is revealed in the region of small angles and large energies of the emitted photons. (orig.).

15567 (DESY–90-139) **Form factor analysis and unitarity effects in $D \to K^*lv$.** Koepp, G. (Technische Hochschule Aachen (Germany, F.R.). Lehrstuhl fuer Experimentalphysik 3A und 3. Physikalisches Inst.); Kramer, G.; Schuler, G.A.; Palmer, W.F. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Nov 1990. 10p. Contract DE-AC02-76ER01545;BMFT 054HH92P/3. Order Number DE91764655. Source: OSTI; NTIS (US Sales Only); INIS.

The large polarization recently reported by Fermilab experiment E691 in $D \to K^* lv$ casts doubt on quark model form factors. We investigate whether unitarity corrections can make the standard quark model consistent with the E691 data. Despite significant corrections, we show that the quark model still can not achieve the high polarization of the E691 data. Unitarity corrections, including CP-odd effects, will be visible in the next generation experiments. (orig.).

15568 (DESY–90-140) **Electroweak multi-particle-production at TeV energies?.** Wetterich, C. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Nov 1990. 10p. Order Number DE91764668. Source: OSTI; NTIS (US Sales Only); INIS.

At very high energies the mean particle multiplicity in electroweak scattering processes should become high, associated with slowly raising total inelastic cross sections. I speculate that this nonperturbative phenomenon may already occur for energies above a few TeV. (orig.).

15569 (DESY–90-144) **Using neural networks to identify jets in hadron-hadron collisions.** Bhat, P. (Fermi National Accelerator Lab., Batavia, IL (USA)); Loennblad, L.; Sugano, Katsuhito; Meier, K. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Nov 1990. 12p. (CONF-9006267–: 1990 DPF summer study on high energy physics, Snowmass, CO (USA), 25 Jun - 13 jul 1990; LU-TP–90-13). Order Number DE91764715. Source: OSTI; NTIS (US Sales Only); INIS.

We investigate the use of neural network techniques to discriminate between quark and gluon jets in Monte Carlo generated panti p collisions. We also investigate the use of this technique to distinguish hadronically decaying W and Z bosons from QCD background. In the latter case we find that the signal-to-background ratio may be increased by more than a factor of 10 using a neural network trigger. (orig.).

15570 (DESY–90-154) **Very energetic photons at HERA.** Bawa, A.C.; Krawczyk, M. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Dec 1990. 14p. Order Number DE91768988. Source: OSTI; NTIS (US Sales Only); INIS.

We show that very energetic photons in the backward direction can be produced in deep inelastic Compton scattering at HERA. Assuming a fixed energy of 9 GeV for the initial photons and 820 GeV for the protons a high rate is found for the production of final photons with a transverse momentum equal to 5 GeV/c and energy between 40 GeV and 300 GeV. These energetic photons arise mainly from the scattering of the soft gluonic constituents of the initial photon with quarks from the proton. They are produced in the backward direction in coincidence with a photon beam jet of energy proportional to 9 GeV in the forward direction. (orig.).

15571 (DOE/ER/40153–7) **Research in particle theory: Annual progress report, December 1, 1989–October 10, 1990.**

Mansouri, F.; Suranyi, P.; Wijewardhana, L.C.R.; Witten, L. Cincinnati Univ., OH (USA). Oct 1990. 15p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-84ER40153. Order Number DE91010749. Source: OSTI; NTIS; INIS; GPO Dep.

A 2+1 dimensional deSitter Chern-Simons theory has been constructed and shown to be consistent. Wilson loop variables have been computed and shown to close under Poisson bracket operation for N = 2 Poincare supergravity. It has also been shown that there are two equivalent pictures of describing two particle scattering in 2+1 dimensional gravity theory, which are related by multivalued gauge transformations. We have generalized the Jackiw-Johnson sumrule, relating Goldstone boson decay constants to the dynamical masses of fermions, to an arbitrary symmetry group. We have analyzed dynamical parity breaking in 2+1 dimensional 4-fermi theories. Finally, we have found the partition function for a system of free parabosons and parafermions of order two. 53 refs.

15572 (DOE/ER/40224–158) **Limit on tau neutrino magnetic moment from neutrino counting.** Deshpande, N.G. (Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science); Sharma, K.V.L. Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science; Tata Inst. of Fundamental Research, Bombay (India). Sep 1990. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG06-85ER40224. (OITS–448). Order Number DE91009567. Source: OSTI; NTIS; INIS; GPO Dep.

By analytical means, using data from neutrino counting at e^+e^- colliders we calculate a limit on the magnetic moment of the tau neutrino. We obtain a limit of $\mu < 8.2 \times 10^{-6}\ \mu_B$ at 90% C.L. 8 refs.

15573 (DOE/ER/40423–13-P90) **The quenched spectrum with staggered fermions.** Gupta, R. (Los Alamos National Lab., NM (USA)); Guralnik, G.; Kilcup, G.W.; Sharpe, S.R. Washington Univ., Seattle, WA (USA). Dept. of Physics. Oct 1990. 34p. Sponsored by USDOE, Washington, DC (USA); National Science Foundation, Washington, DC (USA); Sloan (Alfred P.) Foundation, New York, NY (USA). DOE Contract AS06-88ER40423 ;W-7405-ENG-36. (DOE/ER/01545–445;NSF-ITP–90-172;LA-UR–90-3050). Order Number DE91009613. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper we present results for the hadron spectrum in the quenched approximation using staggered fermions. Pinning down the quenched spectrum is an important step in the program of using lattice calculations to extract physically useful quantities. If we cannot extract the masses of the lightest few states with small errors, and make reliable extrapolations to zero quark mass, then calculations of more complicated quantities are suspect. Furthermore, we would like to know how well the quenched approximation reproduces the physical spectrum, for this gives us some indication of the trustworthiness of other quenched calculations. We present results for the spectrum of QCD in the quenched approximation using staggered fermions at $\beta = 5.7$, 6.0 and 6.2. We use extended wall sources, which give a better projection onto the ground state, and allow us to study many non-local pion and rho states, as well as the Delta baryon. Staggered flavor symmetry breaking reduces dramatically from $\beta = 5.7$ to 6.2. For $\beta = 6$, the ratio m_N/m_ρ lies significantly below 1.5 for $m_q < m_s$. At $\beta = 6$ we study finite volume effects using $16^3 \times 40$ and $24^3 \times 40$ lattices. We reanalyze our old data at $\beta = 6.2$ and resolve the problem of the anomalously light scalar state. 20 refs., 19 figs., 11 tabs.

15574 (FNAL/C–91/72-T) **Hard amplitudes in gauge theories.** Parke, S.J. Fermi National Accelerator Lab., Batavia, IL (USA). Mar 1991. 35p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. Order Number DE91009769. Source: OSTI; NTIS; INIS; GPO Dep.

In this lecture series I presents recent developments in perturbation theory methods for gauge theories for processes with many partons. These techniques and results are useful in the calculation of cross sections for processes with many final state partons which have applications in the study of multi-jet phenomena in high-energy colliders. The results illuminate many important and interesting properties of non-abelian gauge theories. 30 refs., 9 figs.

15575 (IAE–4725-1) **Transformation of covariant quark Wigner operator to noncovariant one.** Selikhov, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 25p. Order Number DE91623903. Source: OSTI; NTIS (US Sales Only); INIS.

The gauge in which covariant and noncovariant quark Wigner operators coincide has been found. In this gauge the representations of vector potential via field strength tensor is valid. The system of equations for the coefficients of covariant Wigner operator expansion in the basis γ-matrices algebra is obtained. 12 refs.; 3 figs.

15576 (IC–90/212) **A dependence of perturbative predictions of extended standard model on Z-Z' mixing and QCD renormalization scheme parameters.** Pankov, A. (International Centre for Theoretical Physics, Trieste (Italy)); Raczka, R.; Satsunkevich, I.S. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 13p. Order Number DE91625395. Source: OSTI; NTIS (US Sales Only); INIS.

In the framework of the minimal extended electroweak models inspired by superstrings, we evaluate the Z_1 boson hadronic and total decay widths, the values R ident to $\sigma(e^+e^- \to \text{hadrons})/\sigma_{pt}$ and R' ident to $\sigma(e^+e^- \to \text{hadrons})/\sigma(e^+e^- \to l^+l^-)$ dependences on Z - Z' mixing parameter and on renormalization scheme parameters. All these values are measured now at LEP. Popular models are discussed for comparison. (author). 23 refs, 6 figs.

15577 (IC–90/271) **Dynamical models of B ->phiJK*+.** Ward, B.F.L. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 11p. Contract DE-AC03-76F00515. (UTHEP–90-1001.). Order Number DE91625400. Source: OSTI; NTIS (US Sales Only); INIS.

An issue of some interest in the general theory of CP violation in B meson decay is the relative admixture of even and odd final CP eigenstates in B ->phi/JK*+. For example, dominance of one sign of CP in this decay would increase the available modes for measuring the CP violation in the respective B meson decays in a beauty factory by a factor ~ 2.5 and, hence, would decrease the luminosity requirements for such a factory from the CP violation perspective. Here, we therefore study this relative admixture in several dynamical models of the respective decay. We are encouraged by our findings. (author). 12 refs, 3 figs.

15578 (IC–90/297) **A general analysis on a complete determination of the 3-vector-boson couplings.** Chen Yuqi (International Centre for Theoretical Physics, Trieste (Italy)); Chang Chaohsi. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 7p. Order Number DE91625381. Source: OSTI; NTIS (US Sales Only); INIS.

Starting from Lorenz invariance and CPT invariance, we write down the most general effective Lagrangian L_{eff} corresponding to the three-vector-boson couplings which are given completely in the Standard Model. 8 refs.

15579 (IC–90/337) **Instantons and charmed baryon mass splittings.** Dey, J. (International Centre for Theoretical Physics, Trieste (Italy)); Dey, M.; Volkovitsky, P. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 5p. Order Number DE91625401. Source: OSTI; NTIS (US Sales Only); INIS.

Masses of baryons with one charmed valence quark are calculated using the approach of Shuryak and Rosner. In their model the masses of vector and scalar diquarks inside baryons are different. It is shown that the parameters of this model for charmed baryons should differ from non-charmed baryons. In the family of such single charmed baryons we predict at least one baryon Ω_c^*, which should decay with the emission of photons, while the rest with $J^P=3/2(\Sigma_c^*$ and $\gamma_c^*)$ might decay via strong interaction with the emission of pions. A generalization of the Gell-Mann Okubo relation and the masses of the single charmed baryons are predicted. (author). 4 refs.

15580 (IC–90/349) **Present status of SU(5)-based grand unifications.** Ahmad, S.M.W. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 13p. Order Number DE91625414. Source: OSTI; NTIS (US Sales Only); INIS.

This paper is a brief communique on the Georgi-Glashow SU(5) paper: Unity of all Elementary Forces, published in 1974; and the

other more important papers based on SU(5) or linked with the Georgi-Glashow paper which was welcomed by many a theoretical physicist as a great step. At the end of the paper, a concise review of the experiments (in operation) and the proposed ones is given. (author). 22 refs.

15581 (IFVE-OEF-OEIUNK–89-192) **Search for rare radiative decay D/f_1(1285)->rho-γ.** Bityukov, S.I. (and others); Dorofeev, V.A.; Dzhelyadin, R.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 8p. Order Number DE91625396. Source: OSTI; NTIS (US Sales Only); INIS.

Search for the rare radiative decay D/f_1(1285)->rho-γ has been carried out. The experimental data have compared with the prediction of different theoretical models and the value for the mixing angle in the nonet of axial-vector mesons is estimated to be: /a/ >17 deg.

15582 (IFVE-OEIUNK–89-200) **K_s^0-regeneration at the UNK energies.** Shelkovenko, A.N. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Teoreticheskoj Fiziki); Struminskij, B.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 14p. Order Number DE91623904. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to the journal Phys. Letters.

A contribution of bare odderon as the reggezied three-gluon exchange to K_s^0-regeneration amplitudes f_{21} on hydrogen is estimated. At the UNK energies odderon is shown to manifest itself mainly in the phase ϕ_{21}, yielding about 20 deg. 19 refs.; 6 figs.

15583 (IFVE-OTF–89-175) **Some properties of vector gluinonium.** Kartvelishvili, V.G.; Tkabladze, A.V.; Chikovani, E.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 8p. (In Russian). Order Number DE91623905. Source: OSTI; NTIS (US Sales Only); INIS.

Strong radiation transitions between the levels of the gluonic bound states are considered. The decay probability for vector gluinonium into Z-bozon and has calculated, and the possibility to observe this state in the Z-bozon and gluon jet.

15584 (IFVE-OTF–89-216) **Transverse part of qusrk-gluon vertex function and quark propagator in infrared region.** Arbuzov, B.A.; Davydychev, A.I.; Kurennoj, S.S. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 20p. (In Russian). Order Number DE91623906. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to the journal Nuovo Cimento.

The Schwinger-Dyson equation for the quark propagator in QCD infrared region is investigated with due regard for gauge identity. The examples of possible transversal arbitrariness in part of the vertex are shown to be able to influence transverse the properties of the solutions is obtained. A class of the solutions, which have massive poles with the mass m, is investigated by the effective potential method. It is shown that starting from some value of the quark bare mass m_0 the solutions with m-:o become energy-preferable. 24 refs.

15585 (INIS-SU–237, pp. 6-7) **Effects of collective neutrinos emission.** Goncharov, N.V. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Polyanskij, V.V. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989. 58p. (In Russian). In *Experimental and theoretical physics: Collection.* Order Number DE91003081. Source: OSTI; NTIS (US Sales Only); INIS.

Possibility of correlative pion decays is considered. A model problem on time evolution of neutrinos number from decay of N_0 π pions, being in V volume, taking into account a weak interparticle interaction, is solved. The reference point is $\pi^+\mu^+\nu_\mu$ sector of weak hamiltoanian (i.e. considered is $\pi^+ \rightarrow \mu^+ + \nu_\mu$ channel). Concurrence of the effects of collective neutrinos emission and their Fermi repulsion is possible at high density of initial particles. It may cause neutinos density oscillations. 3 refs.

15586 (INIS-SU–237, pp. 45-47) **Confinement and hadron production at large angles.** Dremin, I.M.; Nazirov, M.T. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989. 58p. (In Russian). In *Experimental and theoretical physics: Collection.* Order Number DE91003081. Source: OSTI; NTIS (US Sales Only); INIS.

Differences in angular distributions of secondary hadrons in pp and pp-bar interactions in frames of hadron production model, taking into account quark confinement, are predicted. Supposition on confinement role in hadron processes causes production of hadron jets at large angles. Difference of secondary hadron pseudorapidity distributions is expressed in presence of double-peaked spectrum in pp and its absence in pp-bar interactions. Normalized pseudofast distributions don't depend on colliding hadron initial energy. The above mentioned effects are connected with hypothesis on finiteness of l_c lengths and vanish at $l_c \rightarrow \infty$. 7 refs.; 2 figs.

15587 (INIS-SU–238/A, pp. 3-5) **On composition of strange quarks in nucleon.** Efrosinin, V.P. (AN SSSR, Moscow (USSR). Inst. Yadernykh Issledovanij). AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989. 56p. (In Russian). In *Plasma physics: Collection.* Order Number DE91003082. Source: OSTI; NTIS (US Sales Only); INIS.

Evaluation of parameter of Okubo-Zweig-Iizuki rule violation is obtained using the results of a potential model of component quarks and Nambu-Ion-Laginyo generalized model. 10 refs.

15588 (INIS-SU–239, pp. 3-6) **On one simple method of testing scaling character of particle multiple production models in high and superhigh hadron interactions.** Smirnova, M.D.; Smorodin, Yu.A. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989. 44p. (In Russian). In *Quantum radiophysics: Collection.* Order Number DE91003091. Source: OSTI; NTIS (US Sales Only); INIS.

Method of testing scaling character of inclusive distributions in processes of multiple production of particles on the basis of muoin data is suggested. testing is carried out by integral distribution moments and doesn't require calculation of radiation passage through atmosphere. 12 refs., 1 tab.

15589 (INIS-SU–241, pp. 17-21) **Optimal choice of basis functions in the linear regression analysis.** Khotinskij, A.M. Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1988. 86p. (In Russian). In *Techniques and computer codes for numerical solution of mathematical physics problems: Scientific-technical collection.* Order Number DE91003080. Source: OSTI; NTIS (US Sales Only); INIS.

Problem of optimal choice of basis functions in the linear regression analysis is investigated. Step algorithm with estimation of its efficiency, which holds true at finite number of measurements, is suggested. Conditions, providing the probability of correct choice close to 1 are formulated. Application of the step algorithm to analysis of decay curves is substantiated. 8 refs.

15590 (ITEF–143-89) **Diffractive NN-scattering in theory with subcritical pomeron.** Mamkin, O.Yu.; Ponomarev, L.A.; Tarasov, V.E. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 32p. (In Russian). Order Number DE91623910. Source: OSTI; NTIS (US Sales Only); INIS.

Model for amplitude of NN scattering was considered within the framework of Regge scheme with suferitical pomeron. Contribution of processes of diffractive dissociation (DD) in intermediate states was taken into account. Consideration of DD processes in hadron beams of small masses was performed on the basis of Deck model and in the region of large mass by means of summation of intensified diagrams. Cooperative description of the data on total and elastic cross sections and cross sections of single DD in NN interactions at energies of ISR and Spp-barS-collider was conducted. Predictions for cross sections of processes of binary DD, binary pomeron exchange etc. are given. Predictions for various cross sections at higher energies (the region of cosmic data and higher) were made. 24 refs.; 15 figs.

15591 (ITEP–126-89) **Quark-meson mechanism of nucleons weak interaction: effects of antisymmetrization.** Grach, I.L.; Shmatikov, M.Zh. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 24p. Order Number DE91623911. Source: OSTI; NTIS (US Sales Only); INIS.

The mechanism of pairwise quarks' weak interactions due to the one-boson exchanges is considered. The contribution of this mechanism to the longitudinal analyzing power A_L in the low-energy pp-scattering is calculated. The dominant (isoscalar) component of the weak qq-interaction is approximated by the exchange of ρ- and ω-mesons. The strong interaction of quarks is described by means of the potential model. The antisymmetrization effects resulting from the interchange of quarks between nucleons prove to be small ($\lesssim$20+30%). At the same time the calculated value of A_L has the wrong sign implying that the dominant contribution comes from the three-particle quark forces. 15 refs.; 4 figs.

15592 (ITEP–169-89) **Precession of quarks spins in QCD-string model.** Kobzarev, I.Yu.; Martem'yanov, B.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 6p. Order Number DE91623912. Source: OSTI; NTIS (US Sales Only); INIS.

It is argued that precession of quarks spins localized on the ends of rotating QCD-string is defined by Thomas effect only when the string cross section goes to zero. 15 refs.

15593 (ITEP–172-89) **Gluonic excitation in the toronic vacuum.** Pochinskij, A.V.; Simonov, Yu.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 20p. Order Number DE91623913. Source: OSTI; NTIS (US Sales Only); INIS.

The model of the QCD vacuum consisting of toron-antitoron domain structure is suggested. The spectrum of the gluon excitation in SU(2) QCD is obtained. It is shown that in the case of statistical independence of the fields in domains confinement may appear. Arguments in favour of domain structure of vacuum are given from the point of the minimum of free energy. 19 refs.; 3 figs.

15594 (ITEP–174-89) **Three-quark forces and the role of meson exchanges in weak NN interaction.** Grach, I.; Shmatikov, M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 21p. Order Number DE91623914. Source: OSTI; NTIS (US Sales Only); INIS.

The contribution of weak three-quark forces involving meson exchanges to the longitudinal analyzing power A_L in the low-energy pp-scattering is calculated. The nonrelativistic potential model is used for the desorption of strong quark interactions while their weak coupling is described by the Weinberg-Salam lagrangian. The dominant mechanism of parity violation in the NN system (provided the one-pion exchange is forbidden by selection rules) is the contact interaction of quarks. 17 refs.; 3 figs.

15595 (LIYaF–1514) **Six-quark system and algebraic version of resonating-group method. Part 2: 2.Integral kernels and generating matrix elements of potential and kinetic energies.** Smirnov, Yu.F.; Stotland, L.Ya.; Kharitonov, Yu.I. AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki. 1989. 56p. (In Russian). Order Number DE91625402. Source: OSTI; NTIS (US Sales Only); INIS.

This paper is a continuation of earlier paper devoted to the application of the RGM algebraic version in the quark cluster model of the baryon-baryon scattering. For the 3q+3q system the RGM integral kernels of the potential and kinetic energy are obtained. The consideration is limited by 3q-clusters with configuration s^3. The color-electric and color-magnetic qq-forces are taken into account. The generating matrix elements are found that allow to calculate the total matrix of the RGM Hamiltonian in the basis of harmonic oscillator wave functions. 15 refs.; 15 tabs.

15596 (LIYaF–1567) **Conformal invariance and pion wave functions of nonleading twist.** Braun, V.M.; Filyanov, I.E. AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki. 1989. 32p. Order Number DE91623915. Source: OSTI; NTIS (US Sales Only); INIS.

The restrictions are studied for the general structure of pion wave functions of twist 3 and twist 4 imposed by the conformal symmetry and the equations of motion. A systematic expansion of wave functions in the conformal spin is built and the first order corrections to asymptotic formulae are calculated by the QCD sum rule method. In particular, we have found a multiplicatively renormalizable contribution into the two-particle wave function of twist 4 which cannot be expanded in a finite set of Gegenbauer polynomials. 19 refs.; 5 figs.

15597 (LU-TP–90-4) **Fluctuations and anomalous dimensions in QCD cascades.** Andersson, B.; Gustafson, G.; Nilsson, A.; Sjoegren, C. Lund Univ. (Sweden). Dept. of Theoretical Physics. Apr 1990. 23p. Order Number DE91625404. Source: OSTI; NTIS (US Sales Only); INIS.

A recently proposed multiplicity measure is used to study the properties of QCD cascades. We show that it is possible to define anomalous dimensions locally in rapidity space for the QCD cascade in e^+e^- annihilation events and in deep inelastic lepton scattering. In this way it will be possible to differ between different suggested models for multiple gluon emission. We also show that the properties of an event are to a surprisingly large degree determined by the first one or two gluons. Thus e.g. the multiplicity fluctuations in e^+e^- annihilation at the Z^0-pole are to about 90% determined by the hardest gluon. This implies that it may be principally difficult to make a distinct separation between the hard perturbative phase and the soft hadronization phase. (authors).

15598 (LU-TP–90-7) **Fractal structures and intermittency in perturbative QCD cascades.** Gustafson, G.; Nilsson, A. Lund Univ. (Sweden). Dept. of Theoretical Physics. May 1990. 13p. Order Number DE91625405. Source: OSTI; NTIS (US Sales Only); INIS.

New results are presented for fractal structures and intermittency in QCD parton showers. The particle momenta define a fractal curve in energy-momentum space with a dimension $1 + \sqrt{3\alpha_s/2\pi}$. This gives a geometrical interpretation of the anomalous dimension in QCD. For the distribution in smaller angular region we see that the corresponding multifractal dimension are the same if we bin in γ or phi or do a two-dimensional analysis in γ and phi. (author).

15599 (LU-TP–90-11) **Intermittency in e^+e^- -annihilation at PEP-PETRA energies.** Gustafson, G.; Sjoegren, C. Lund Univ. (Sweden). Dept. of Theoretical Physics. Jun 1990. 13p. Order Number DE91625403. Source: OSTI; NTIS (US Sales Only); INIS.

Data on multiplicity moments in small rapidity windows can be reproduced in the string fragmentation model if the properties of directly produced pions are taken properly into account. The direct pions resolve the underlying parton structure better than the more massive resonances. From the tunneling production mechanism these pions are supposed to have smaller transverse rho than other particles, a property which has been neglected in the MC programs. This can also explain the high K/π ratio observed at large transverse rho in pp-collisions. We also find that the result is sensitive to the cut-off for the perturbative QCD cascade. If α_s is allowed to grow like 1/ln(transverse κ^2/Λ^2) a small value for the cut-off implies that the perturbative treatment is not appropriate. In this case the state becomes too chaotic. (authors).

15600 (NBI-HE–90-73) **W-condensate formation in high energy collisions.** Ambjoern, J.; Olesen, P. Niels Bohr Inst., Copenhagen (Denmark). Nov 1990. 11p. Order Number DE91623883. Source: OSTI; NTIS (US Sales Only); INIS.

We point out that there exists the possibility that a W- and Z-condensate is formed at LHC and SSC collider energies. The condensate can be triggered by the strong transient magnetic fields present during the collision, and/or by creation of magnetic flux tubes in weak interactions. The condensate is assumed to be metastable, and decays into W's, Z's, leptons and/or quarks. Thus it should show up in an anomalous production of these particles. (orig.).

15601 (NIKHEF-H–90-19) **QCD radiative corrections to charged current heavy quark production.** Bij, J.J. van der (Amsterdam Univ. (Netherlands). Inst. voor Theoretische Fysica); Oldenborgh, G.J. van. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. Nov 1990. 17p. Order Number DE91623896. Source: OSTI; NTIS (US Sales Only); INIS.

The QCD radiative corrections to charged current heavy quark production are given in the limit that the weak partner is massless,

i.e. using a bottom structure function for top quark production. The results for charm production in neutrino nucleon scattering agree with those published before, but our method enables us to study all outgoing particles. The corrections to top production at the proposed LEP/LHC electron-proton collider are discussed. (author). 18 refs.; 6 figs.; 2 tabs.

15602 (NIKHEF-H-90-20) **Sphalerons and energy barriers in the Weinberg-Salam theory.** Klinkhamer, F.R. (CHEAF, Amsterdam (Netherlands)). Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. Oct 1990. 7p. (CONF-900822--: 25. IUPAP international conference on high energy physics, Singapore (Singapore), 2-8 Aug 1990). Order Number DE91625382. Source: OSTI; NTIS (US Sales Only); INIS.

To appear in: Proceedings of the 25th International conference on high energy physics, Singapore 2-8 August 1990 / K.K. Phua and Y. Yamaguchi (eds.).

The author discusses some recent results regarding non-trivial structure in the configuration space of the electro-weak standard and related classical solutions (sphalerons). (author). 17 refs.; 5 figs.

15603 (NIKHEF-H-90-22) **On the electrodynamics of spinning particles.** Holten, J.W. van (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. 5 Dec 1990. 28p. Order Number DE91625397. Source: OSTI; NTIS (US Sales Only); INIS.

The electrodynamics of spinning point particles is considered. A modification of the Lorentz force law is introduced which can be interpreted as a classical limit of the Dirac-Klein-Gordon equation. An improved version of the inhomogeneous Maxwell equations is constructed to describe the classical fields of spinning particles. Both classical and quantum electrodynamics are shown to predict relativistic time-dilatation effects for spinning particles in an electromagnetic field, even in the limit of zero velocity. The life-time of unstable charged particles moving in a Coulomb field is computed for both spin-zero and spin-half particles. Comparison shows spin effects to be present but relatively small. The magnitude of further spin-dependent correction from hyperfine interactions is computed. A measurement of the life-time of muons in atomic bound states separated by such spin-dependent hyperfine interactions would provide a clean test for the effect predicted. Similar effects are shown to arise in non-abelian gauge theories such as QCD. (author). 18 refs.

15604 (NIKHEF-H-90-23) **The α^3_S corrections to the Bjorken sum rule for polarized electro-production and to the Gross-Llewellyn Smith sum rule.** Larin, S.A. (Academy of Sciences, Moscow (USSR). Institute for Nuclear Research); Vermaseren, J.A.M. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. 1990. 15p. Order Number DE91625383. Source: OSTI; NTIS (US Sales Only); INIS.

Includes report NIKHEF-H-90-18: The α^3_S correction to the Bjorken sum rule / by S.A. Larin; F.V. Tkachov (Academy of Sciences, Moscow (USSR). Institute for Nuclear Research); J.A.M. Vermaseren (4399930NL). - 4 p. - 12 refs.

The next-next-to-leading order QCD corrections to the Gross-Llewellyn Smith sum rule for deep inelastic neutrino-nucleon scattering and to the Bjorken sum rule for polarized electron-nucleon scattering have been computed. This involved the proper treatment of γ_5 inside the loop integrals with dimensional regularization. It is found that the difference between the two sum rules are entirely due to a class of 6 three loop graphs and is of the order of 1% of the leading QCD term. Hence the Q^2 behavior of both sum rules should be the same if the physics is described adequately by the lower order terms of perturbative QCD. (author). 12 refs.; 2 figs.; 4 tabs. Includes report NIKHEF-H-90-18: The α^3_S correction to the Bjorken sum rule /by S.A. Larin; F.V. Tkachov (Academy of Sciences, Moscow (USSR). Institute for Nuclear Research); J.A.M. Vermaseren (4399930NL). - 4 p. - 12 refs.

15605 (OUP-90-26) **Direct CP violation in $K_{L,S} \rightarrow 2\gamma$ transitions for an arbitrary mass.** Eeg, J.O. (Oslo Univ. (Norway). Fysisk Inst.); Nizic, B.; Picek, I. Oslo Univ. (Norway). Fysisk Inst. Oct 1990. 8p. Order Number DE91623884. Source: OSTI; NTIS (US Sales Only); INIS.

Short-distance contributions to K° (anti K°) $\rightarrow \gamma\gamma$ with the standard model for large m_t, including QCD corrections, are studied. Owing to a relaxed GIM suppression, CP violation in the decay amplitude turns out to be more important than previously thought and might be of order 20% of that coming from the mass matrix. This leads to rare $K_{L,S} \rightarrow \gamma\gamma$ decays as potentially interesting candidates for testing direct CP violation at LEAR and Φ factories. Still, it does not seem to be achievable by the luminosities foreseeable for forthcoming Φ factories. 12 refs., 2 figs.

15606 (OUP-90-32) **Contribution to $\Lambda^+_c \rightarrow \phi\Sigma$, $\phi\Lambda$ and p anti K° from excited states.** Turan, G.; Eeg, J.O. Oslo Univ. (Norway). Fysisk Inst. Dec 1990. 19p. Order Number DE91623885. Source: OSTI; NTIS (US Sales Only); INIS.

Contributions to $\Lambda_c^+ \rightarrow \phi\Sigma$, $\phi\Lambda$ and p anti K° from excited states are considered. The calculations are performed within the MIT-bag model and a Heavy Quark bag model. Because the mass of Λ_c^+ is rather big compared to the strange baryons, excited baryon states with mass close to that of Λ_c^+ in some cases give significant pole contributions to the decay amplitudes of Λ_c^+. 20 refs., 3 tabs.

15607 (RAL-90-079) **Five jet production in e^+e^- annihilation above the W^+W^- threshold.** Brown, N. Rutherford Appleton Lab., Chilton (UK). Nov 1990. 10p. Order Number DE91623886. Source: OSTI; NTIS (US Sales Only); INIS.

Above the W^+W^- threshold, gluon bremsstrahlung from the decay of W bosons into quark pairs gives rise to five jet configurations. At lowest quantum chromodynamic order this dominates over the point like five jet production, and allows the hadronic decays of the W to be tested with QCD. Some results for integrated cross-sections and jet distributions are given. (author).

15608 (RAL-90-080) **Cross sections for five jet production above the W^+W^- threshold in e^+e^- annihilation.** Brown, N. Rutherford Appleton Lab., Chilton (UK). Nov 1990. 18p. Order Number DE91623887. Source: OSTI; NTIS (US Sales Only); INIS.

We describe the calculation of five jet production from the W^+W^- intermediate state in e^+e^- annihilation in lowest order quantum chromodynamics. Some results for integrated Cross-sections are presented. (author).

15609 (SSCL-373) **From QCD to Chiral Dynamics: A smooth transition.** Morozumi, T. (Rockefeller Univ., New York, NY (USA)); Rebelo, M.N.; Sanda, A.I. Superconducting Super Collider Lab., Dallas, TX (USA). Mar 1991. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-89ER40486. Order Number DE91011001. Source: OSTI; NTIS; INIS; GPO Dep.

We study the transition from perturbative QCD to Chiral Dynamics (linear σ model), which describe physics between M_W and μ, and between μ and M_π, respectively. This is done within the context of K decays. The smoothness of the transition is shown by comparing the explicit form of the anomalous dimension matrices in both pictures and by checking the approximate cancellation of the μ dependence. 6 refs., 2 figs.

15610 (USIP-90-03) **Democratic Monte-Carlo generation of hadronic fragments with conserved momentum.** Berggren, M. Stockholm Univ. (Sweden). Inst. of Physics. Sep 1990. 15p. Order Number DE91625406. Source: OSTI; NTIS (US Sales Only); INIS.

A general method to generate a set of random numbers, constrained by the requirement that their sum should vanish is presented. The numbers will be democratically generated, i.e. the distribution of each of them will be the same, as well as the correlation between any pair. It is also shown that this is not the case in a cascade model, were the constraint is fulfilled by calculating the last number from the sum of the others. The simultaneous distribution of the momenta is given in a closed form in the case where the individual momenta have gaussian distributions. (author).

6453 Particle Invariance Principles and Symmetries

Refer also to citation(s) 15573, 15642, 15853, 15862

15611 (DESY–90-161) **Spectrum of the effective SU(3)-hamiltonian in a small volume computed by path integral Monte Carlo.** Tiedemann, H. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Dec 1990. 18p. Order Number DE91768984. Source: OSTI; NTIS (US Sales Only); INIS.

Using a simple Monte Carlo integration method for quantum mechanical problems on a 'time lattice' the massgaps of the low lying states of Luescher's effective hamiltonian with and without massless fermions for a small volume are computed. While there is good agreement between this method and previous Rayleigh-Ritz type calculations in the case of SU(2), no-table differences are found in the case of SU(3) for most states. The statistical and systematic errors are competitive with those of the variational method. Having no dependence on basis set size the Monte Carlo method is a good alternative to the Rayleigh-Ritz calculations also for SU(3). An extension of the method to intermediate volumes including fermions is definitively possible. (orig.).

15612 (ITEP–134-89) **Spontaneously broken version of N=4 supersymmetry.** Terent'ev, M.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 8p. Order Number DE91623544. Source: OSTI; NTIS (US Sales Only); INIS.

The special scenario of reduction from the space of D=10 dimensions is used to construct the theory with describes interaction of supergravity with only one multiplet of matter in the framework of spontaneously broken N=4 supersymmetry. 6 refs.; 1 fig.

6454 Field Theory

Refer also to citation(s) 15571, 15573, 15574, 15838

15613 (CONF-9007185–1) **Are there background fields that can induce QED phase transitions at weak coupling?.** Ng, Y.J. (North Carolina Univ., Chapel Hill, NC (USA). Dept. of Physics and Astronomy); Kikuchi, Y. North Carolina Univ., Chapel Hill, NC (USA). Dept. of Physics and Astronomy. Sep 1990. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-85ER40219. From NATO advanced study institute on vacuum structure in intense fields; Cargese (France); 30 Jul - 11 aug 1990. Order Number DE91010745. Source: OSTI; NTIS; INIS; GPO Dep.

The existence of a new, non-perturbative phase of QED as indicated by studies of Schwinger-Dyson equations and lattice calculations. The crucial question is whether the phase transition point can be driven down to $\alpha \sim 1/137$ presumably by appropriate background fields. It appears that magnetic fields potentially can induce such a phase transition. Our investigation is related to our original conjecture that the anomalous e^+e^- events at GSI are due to the decay of a new positronium system formed in the new QED phase which is induced by the electromagnetic fields of the heavy-ions. 25 refs.

15614 (DESY–90-118) **QED at strong coupling.** Schierholz, G. (Hoechstleistungsrechenzentrum (HLRZ), Juelich (Germany, F.R.). Gruppe Theorie der Elementarteilchen). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Oct 1990. 20p. (CONF-9007180–: 1990 international workshop on strong coupling gauge theories and beyond, Nagoya (Japan), 28-31 Jul 1990; HLRZ–90-080). Order Number DE91764666. Source: OSTI; NTIS (US Sales Only); INIS.

One of the most fundamental questions in field theory is whether QED has a non-trivial continuum limit. In this talk I shall review recent lattice work which addresses this problem. The key-issue is the determination of the renormalization group flow and the derivation of the Callan-Symanzik β-function. The β-function does not show an ultra-violet stable zero, but is consistent with the prediction of renormalized perturbation theory. This indicates triviality. The question to what extent QED is a valid low-energy theory is raised. Furthermore, the anomalous dimension and the critical exponents of the fermion mass operator are examined. (orig.).

15615 (DESY–90-126) **Stochastic cluster algorithms for discrete Gaussian (SOS) models.** Evertz, H.G. (Florida State Univ., Tallahassee (USA). Supercomputer Computations Research Inst. (SCRI)); Hasenbusch, M.; Marcu, M. Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Oct 1990. 11p. Grant GIF I-131-095.07/89;GIF 517/89. (TAUP–1836-90). Order Number DE91764659. Source: OSTI; NTIS (US Sales Only); INIS.

We present new Monte Carlo cluster algorithms which eliminate critical slowing down in the simulation of solid-on-solid models. In this letter we focus on the two-dimensional discrete Gaussian model. The algorithms are based on reflecting the integer valued spin variables with respect to appropriately chosen reflection planes. The proper choice of the reflection plane turns out to be crucial in order to obtain a small dynamical exponent z. Actually, the successful versions of our algorithm are a mixture of two different procedures for choosing the reflection plane, one of them ergodic but slow, the other one non-ergodic and also slow when combined with a Metropolis algorithm. (orig.).

15616 (DESY–90-158) **Projective block spin transformations in lattice gauge theories.** Kalkreuter, T. (Hamburg Univ. (Germany, F.R.). 2. Inst. fuer Theoretische Physik). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Dec 1990. 27p. Order Number DE91768987. Source: OSTI; NTIS (US Sales Only); INIS.

A block spin definition for Higgs fields and non-Abelian lattice gauge fields is examined which is in the spirit of the projective multigrid procedure of Brower, Rebbi and Vicari. The block spin transformation involves a gauge covariant kernel C which makes the fine to coarse transition, and a kernel A which makes the coarse to fine interpolation. These kernels could be used in a projective multigrid computation of propagators, for instance. Vectorizable algorithms for the computation of C and A are presented. For SU(2) lattice gauge theory in 4 dimensions, the required CPU time for computing C or A on the whole lattice is comparable to that for one standard Monte Carlo sweep through the lattice. Numerical results obtained after performing one blocking transformation from a 9^4 to a 3^4 lattice are presented. The block spin computation yields auxiliary quantities of interest, such as the lowest eigenvalues λ_0, λ_0' of the negative gauge covariant Laplacian with Neumann and Dirichlet boundary conditions on block boundaries. λ_0 and λ_0' are measures of disorder and their renormalization group flow is therefore instructive. (orig.).

15617 (DESY–90-159) **Advances in lattice QED.** Schierholz, G. (Hoechstleistungsrechenzentrum (HLRZ), Juelich (Germany, F.R.). Gruppe Theorie der Elementarteilchen). Deutsches Elektronen-Synchrotron (DESY), Hamburg (Germany, F.R.). Dec 1990. 14p. (CONF-901072–: LATTICE '90: 7th international lattice gauge theory conference, Tallahassee, FL (USA), 8-12 Oct 1990; HLRZ–90-101). Order Number DE91768983. Source: OSTI; NTIS (US Sales Only); INIS.

In this talk I review recent lattice work on the ultra-violet behavior of QED. Of particular interest is the question whether QED has a non-trivial continuum limit or not. (orig.).

15618 (IAE–4948-1) **Expansion of the transformations of reciprocal radius-vectors into a set of transformations belonging to the Weyl group: Conformal dimension of electromagnetic field.** Kotel'nikov, G.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 7p. (In Russian). Order Number DE91623503. Source: OSTI; NTIS (US Sales Only); INIS.

It is shown that the transformations of reciprocal radius-vectors can be expanded into four sets of transformations belonging to the Weyl group. The formulas of the transformation of the components of electromagnetic field, current and charge densities as well as potentials for the case of two-charge electrodynamics are given. The conform dimensionality is 0 for the electromagnetic charges, -1 for the potentials, -2 for the fields, -3 for the current and charge densities, -4 for the difference of the squares of fields. The electromagnetic charges are transformed so that of one if them is scalar, other is pseudoscalar. The difference in their transformation properties means that the electric charge will not interact with the fields of the magnetic charge and vice versa. This can be a reason of the unsuccessful attempts to register the Dirac monopole. 12 refs.

15619 (IC–90/208) **Field theory approach to quantum hall effect.** Cabo, A. (International Centre for Theoretical Physics, Trieste (Italy)); Chaichian, M. International Centre for Theoretical Physics, Trieste (Italy). Jul 1990. 20p. (CERN-TH–5869/90.). Order Number DE91625215. Source: OSTI; NTIS (US Sales Only); INIS.

The Fradkin's formulation of statistical field theory is applied to the Coulomb interacting electron gas in a magnetic field. The electrons are confined to a plane in normal 3D-space and also interact with the physical 3D-electromagnetic field. The magnetic translation group (MTG) Ward identities are derived. Using them it is shown that the exact electron propagator is diagonalized in the basis of the wave functions of the free electron in a magnetic field whenever the MTG is unbroken. The general tensor structure of the polarization operator is obtained and used to show that the Chern-Simons action always describes the Hall effect properties of the system. A general proof of the Streda formula for the Hall conductivity is presented. It follows that the coefficient of the Chern-Simons terms in the long-wavelength approximation is exactly given by this relation. Such a formula, expressing the Hall conductivity as a simple derivative, in combination with diagonal form of the full propagator allows to obtain a simple expressions for the filling factor and the Hall conductivity. Indeed, these results, after assuming that the chemical potential lies in a gap of the density of states, lead to the conclusion that the Hall conductivity is given without corrections by $\sigma_{xy} = \nu e^2/h$ where ν is the filling factor. In addition it follows that the filling factor is independent of the magnetic field if the chemical potential remains in the gap. (author). 21 ref, 1 fig.

15620 (IC–90/235) **Has the classical vacuum a conformal structure?.** Culetu, H. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 6p. Order Number DE91625216. Source: OSTI; NTIS (US Sales Only); INIS.

A possible existence of a conformal perfect fluid in the classical vacuum is investigated in this letter. It is shown, contrary to Madsen's opinion, that the scalar field stress tensor acquires a perfect fluid form even with a non-minimal coupling ($\xi = 1/6$), provided the geometry is the conformally flat Hawking wormhole. It is found that the flow vector U^μ does not vanish far from the light cone, even if the scalar field becomes constant. (author). 10 refs.

15621 (IC–90/278) **On the zero mode of the Poisson gauge theory.** Saidi, E.H. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 11p. Order Number DE91625217. Source: OSTI; NTIS (US Sales Only); INIS.

The fundamentals of the Diff(S^2) and the SDiff(S^2) gauge theories are developed. It is shown that the adjoint representation of SU(∞) is described by a divergentless two dimensional vector field defined on the sphere. The SU(∞) Yang-Mills gauge action obtained earlier by Floratos et al. is reviewed. The problem of the zero modes is solved without need of any constraint. The fundamental representations of SU(∞) and the gauge matter couplings are discussed. (author). 6 refs.

15622 (IFVE-OTF–89-176) **The Gaussian effective potential method and Higgs sector in some grand unification models.** Klimenko, K.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 19p. Order Number DE91623504. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to the journal Zeit.fur Physik c.

The quantum theories where scalar fields are transformed over (1) adjoint and vector representations of the O(N) group, and (2) adjoint and fundamental representations of the SU(N) group, are investigated with aid of Gaussian effective potential method. It is shown, that there exist autonomous phases with spontaneous breaking of the initial symmetry. refs. 13.

15623 (IFVE-OTF–89-204) **The supersymmetric vector-like horizontal model with intermediate symmetry breaking scale.** Amaglobeli, A.N. (AN Gruzinskoj SSR, Tbilisi (USSR). Tbilisskij Matematicheskij Inst.); Kereselidze, A.R.; Lipparteliani, A.G.; Volkov, G.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 10p. Order Number DE91623505. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to the journal Physics. Letters.

The supersymmetric version of vector-like horizontal gauge interactions is considered. Several symmetry breaking schemes are studied. Our analysis shows that the current experimental data for rare decays still leave a possibility for low-scale horizontal gauge bosons (1-10 TeV) and gauginos (0.25-0.5 TeV) to exist. 13 refs.

15624 (INIS-SU–232, pp. 21-27) **Dirac equation in Foldy-Wouthuysen representation (expansion in terms of charge e powers).** Neznamov, V.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1988. 43p. (In Russian). In *Theoretical and applied physics: Scientific-technical collection.* Order Number DE91003077. Source: OSTI; NTIS (US Sales Only); INIS.

Formalism of deriving Dirac equation in Foldy-Wouthuysen representation in the form of a series of e charge powers with the presence of common external electromagnetic field is described. Method for producing an unitary transformation matrix U'_{FW} and a two-component Hamiltonian H'_{FW} is presented. In the obvious force H'_{FW} Hamiltonian is extracted up to $\approx e^2$ terms inclusive. Some limiting cases are discussed. 4 refs.

15625 (INS–860) **Topological pregauge-pregeometry.** Akama, Keiichi (Saitama Medical Coll., Moroyama (Japan)); Oda, Ichiro. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Dec 1990. 14p. Order Number DE91767972. Source: OSTI; NTIS (US Sales Only); INIS.

The pregauge-pregeometric action, i.e. the fundamental matter action whose quantum fluctuations give rise to the Einstein-Hilbert and the Yang-Mills actions is investigated from the viewpoint of the topological field theory. We show that the scalar pregauge-pregeometric action is a topological invariant for appropriate choices of the internal gauge group. This model realizes the picture that the gravitational and internal gauge theory at the low energy scale is induced as the quantum effects of the topological field theory at the Planck scale. (author).

15626 (ITEP–101-89) **Green's functions of solitons in heat bath.** Smilga, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 32p. Order Number DE91623507. Source: OSTI; NTIS (US Sales Only); INIS.

Soliton Green's functions at nonzero temperature are studied. Considering various model example it is shown that the Green's function pole position does not coincide generally speaking with free energy of a soliton. The Froelich polaron and the t'Hooft-Polyakov monopole the Green's function for which is in general a poorly defined concept as it involves an infinite imaginary part connected to the infinite total cross section of monopole scattering by electric charge are discussed. The pole position of the Green's function of the collective sphaleron excitation in the Glashow-Weinberg-Salem model does not as well coincide with the sphaleron free energy. 24 refs.; 9 figs.

15627 (ITEP–112-89) **Conformal field theory and 2D critical phenomena. Part 1: 1.Algebra of local fields.** Zamolodchikov, A.B.; Zamolodchikov, Al.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 32p. Order Number DE91625218. Source: OSTI; NTIS (US Sales Only); INIS.

Review of the recent developments in the two-dimensional conformal field theory and especially its applications to the physics of 2D critical phenomena is given. It includes the Ising model, the Potts model. Minimal models, corresponding to theories invariant under higher symmetries, such as superconformal theories, parafermionic theories and theories with current and W-algebras are also discussed. Non-hamiltonian approach to two-dimensional field theory is formulated. 126 refs.

15628 (ITEP–144-89) **Thermodynamic Bethe anzats in relativistic models: Scaling 3-state Potts and Lee-Yang models.** Zamolodchikov, Al.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 32p. Order Number DE91623508. Source: OSTI; NTIS (US Sales Only); INIS.

Two integrable 2D relativistic field theory models are studied by the thermodynamic Bethe anzats method. One of them describes the scaling limit $T \to T_c$ of the 3-state Potts model and the other corresponds to the scaling region near the Lee-Yang singularity of the 2D Ising model. The finite volume ground state energy of these two theories is calculated numerically using the integral equations of the temperature Bethe anzats approach. Numerical results are compared with the perturbations near the corresponding conformal theories. 18 refs.; 5 figs.

15629 (ITEP–146-89) **A note on W_3-algebra.** Marshakov, A.; Morozov, A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 16p. Order Number DE91623509. Source: OSTI; NTIS (US Sales Only); INIS.

A reduced SL(3) Wess-Zumino-Witten model realized in terms of two free fields which posesses SL(3) invariance is considered. The operators W_2 and W_3 of refs. (1,2,3) are the Noether currents of this theory. This is direct generalization of the SL(2) case (two-dimensional gravity). 12 refs.; 1 fig.

15630 (ITEP–154-89) **Straightforward proof of Lechtenfeld's formula for β,γ-correlator.** Morozov, A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 8p. Order Number DE91623510. Source: OSTI; NTIS (US Sales Only); INIS.

General method of evaluation of correlators of bosonic $\beta\gamma$-fields with linear Lagrangian is applied to the derivation of Lechtenfeld's formula, important for development of the first-quantized formalism for superstring. 9 refs.

15631 (ITEP–155-89) **On a manifestation of the anomalies in the massless QED.** Gorskij, A.S. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 8p. Order Number DE91625219. Source: OSTI; NTIS (US Sales Only); INIS.

The questions concerned with the axial and conformal anomalies in the massless QED are discussed. It is shown that the interaction of the longitudinal real photons is proportional to the β function of the theory and the corresponding matrix element $<\gamma^L|\Theta_{\alpha\beta}|\gamma^L>$ where $\Theta_{\alpha\beta}$ is energy-momentum tensor has a common features with the nonvanishing matrix element $<\gamma|A_\alpha|\gamma>$ in the massless limit. 7 refs.; 2 figs.

15632 (ITEP–161-89) **Truncated conformal space approach to scaling Lee-Yang model.** Yurov, V.P.; Zamolodchikov, Al.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 32p. Order Number DE91623511. Source: OSTI; NTIS (US Sales Only); INIS.

A numerical approach to 2D relativstic field theories is suggested. Considering a field theory model as an ultraviolet conformal field theory perturbed by suitable relevant scalar operator one studies it in finite volume (on a circle). The perturbed Hamiltonian acts in the conformal field theory space of states and its matrix elements can be extracted from the conformal field theory. Truncation of the space at reasonable level results in a finite dimensional problem for numerical analyses. The nonunitary field theory with the ultraviolet region controlled by the minimal conformal theory $\mu(2/5)$ is studied in detail. 9 refs.; 17 figs.

15633 (ITEP–166-89) **Vortices on the string and superstring world sheets.** Abrikosov, A.A.; Kogan, Ya.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 36p. Order Number DE91623512. Source: OSTI; NTIS (US Sales Only); INIS.

The world-sheet dynamics of the first quantized string propagating in non-simply connected space is considered. Presence of the vortices on the world sheet lead to Berezinsky-Kosterlitz-Thouless(BKT) phase transition. Bosonic and superstring cases are discussed. 20 refs.; 2 figs.

15634 (ITEP–173-89) **Conformal field theory and 2-d critical phenomena. Part 2: 2.Renormalization group and conformal symmetry.** Zamolodchikov, A.B.; Zamolodchikov, Al.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 28p. Order Number DE91623513. Source: OSTI; NTIS (US Sales Only); INIS.

General properties of the renormalization group in 2D relativistic field theory are considered including the directed character of the renormalization group flow (c-theorem). In a fixed point of the renormalization group flow 2D field theory develops additional infinite dimensional space-time symmetry it becomes invariant under 2D conformal transformations. The appearance of Virasoro algebra in the fixed point conformal field theory is demonstrated and general properties of the conformal stress tensor are discussed. The decomposition of the conformal field theory space of states into Virasoro algebra irreducible representations is considered. 17 refs.

15635 (IYaF–89-31) **Preliminary results of searching for exotic long-range interaction violating T invariance.** Vorob'ev, P.V. AN SSSR, Novosibirsk (USSR). Inst. Yadernoj Fiziki. 1989. 14p. (In Russian). Order Number DE91623514. Source: OSTI; NTIS (US Sales Only); INIS.

The preliminary experimental results of searching for exotic long-range interaction, violating T and P invariances, are described. Restrictions for the interaction constants are given. A possibility of sensitivity improvement in new experiments, prepared in the Institute of Nuclear Physics, is discussed. 16 refs.; 4 figs.; 5 tabs.

15636 (KEK–90-8) **A new techniques to deal with weakly non integrable Hamiltonians.** Hagel, J. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Jun 1990. 28p. Order Number DE91767862. Source: OSTI; NTIS (US Sales Only); INIS.

New type of integration theory applicable to weakly non integrable Hamiltonians is introduced. It consists of reducing Hamiltons equations to a single linear partial differential equation containing a perturbation parameter which measures the strength of the non integrable part of the Hamiltonian. The solution of this equation leads immediately to a first integral of the underlying system. Because of the linearity of the partial differential equation perturbation theory leads to a very simple recurrence, which relates a given order solution to only the solution of the previous order unlikely to perturbation techniques being applied to nonlinear equations. The here presented techniques can be applied also to integrable Hamiltonians in which case the perturbation series truncates after some given order. This is the case for the example of the well known single resonance Hamiltonian. The theory then is applied to the non integrable case of the two-resonance Hamiltonian. In this case the perturbation series does not converge in general, but shows semi-convergent properties. (author).

15637 (NBI-HE–90-66) **Symmetry breaking as a consequence of stabilization of a bottomless theory.** Bogojevic, A.R. Niels Bohr Inst., Copenhagen (Denmark). Nov 1990. 12p. Order Number DE91623515. Source: OSTI; NTIS (US Sales Only); INIS.

The Greensite-Halpern stabilization technique is applied to d=0 Euclidean field theories. The effective action is calculated using WKB as well as a variational approach. For a set of free theories with non-trivial measure the effective action is computed exactly, and a comparison is made with the results of approximate techniques. The effect of stabilization on the measure is to bring in a 'centrifugal barrier' term that breaks parity invariance. A model with quartic interaction of wrong sign is also analyzed in the limit of large coupling. (orig.).

15638 (NBI-HE–90-69) **1/N-expansions of σ-models in 2 and 4 dimensions: Taking them to their technical limits.** Flyvbjerg, H.; Larsen, F.; Kristjansen, C. Niels Bohr Inst., Copenhagen (Denmark). Nov 1990. 4p. Order Number DE91623516. Source: OSTI; NTIS (US Sales Only); INIS.

The mass gap and the magnetic susceptibility of the non-linear σ-model in 2d are given as functions of β to three leading orders in 1/N up to correlation lengths 300-400. Our results agree with Monte Carlo results for $N \geq 3$, and, for large β, with recent Bethe ansatz results for the correlation length. With applications to the Higgs sector of the Standard Model in mind, we have tested the precision of the 1/N-expansion of the N-component ϕ^4 theory in 4d for N=4. In the theory's symmetric phase very satisfactory precision is obtained already to two leading orders in 1/N, except at very

strong coupling. In the physically interesting broken phase prospects are less encouraging. (orig.).

15639 (NBI-HE-90-70) **Interpolating between O(N)-symmetric σ-models with N=1,2,3.** Klomfass, M. (Florida State Univ., Tallahassee (USA). Supercomputer Computations Research Inst. (SCRI)); Heller, U.M.; Flyvbjerg, H. Niels Bohr Inst., Copenhagen (Denmark). Nov 1990. 4p. Contract DE-FC05-85ER250000. Order Number DE91623517. Source: OSTI; NTIS (US Sales Only); INIS.

We interpolate between the O(N)- and the O(N-1)-symmetric non-linear σ-models with standard action by suppressing the Nth component of the N-vector field with a mass term. We find a critical line in the coupling-mass plane connecting the critical point of the Ising model (N=1) with the critical point of the XY-model (N=2). This line extends towards the region of non-monotonous behaviour of the β-function of the O(3)-symmetric model. The massless phase of the XY-model is separated from the ordered phase of the Ising model by a transition at zero mass, while it is separated from the only phase of the O(3)-model by a transition that seems to occur at exponentially small mass. (orig.).

15640 (NIIYaF-MGU-88-50-71) **Non-Noether symmetries and conservation laws.** Lunev, F.A. Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1988. 12p. (In Russian). Order Number DE91623518. Source: OSTI; NTIS (US Sales Only); INIS.

It is shown that local conserved current can be brought to conformity with each pair of non-Noether symmetries in Lagrangian field theory. Generalization of this result for a non-Lagrangian case is given. 7 refs.

15641 (NIIYaF-MGU-89-32-109) **Symmetrically-recursion operator in bi-Lagrangian theories.** Lunev, F.A. Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1989. 10p. (In Russian). Order Number DE91623519. Source: OSTI; NTIS (US Sales Only); INIS.

Theorem about the existence of symmetrically-recursion operator in bi-Lagrangian theories has been proposed. The theorem is valid for a wide range of equations with local and nonlocal Lagrangians, with commutating and anticommutating variables. Symmetrically-recursion operator and corresponding higher symmetries and higher conservation laws in classical electrodynamics have been constructed as an example. 7 refs.

15642 (NIKHEF-H-89-8) **Generalized killing equations and symmetries of spinning space.** Rietdijk, R.H. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H); Holten, J.W. van. Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. Apr 1989. 13p. Order Number DE91623520. Source: OSTI; NTIS (US Sales Only); INIS.

The authors derive a set of general conditions for the isometrics of d-dimensional spinning space. These equations constitute a Grassmann-valued extension of the Killing equations for ordinary space. They are realized as invariances of spinning-particle actions. Some general solutions for the extended Killing equations in arbitrary curved space are presented. Thus the spinning particle in d-dimensions can be shown to possess new types of (super-)symmetries, which transform the commuting and anti-commuting co-ordinates (X^μ, ψ^μ) not only linearly, but also non-linearly. The authors present the algebra of these non-linear transformations. They give a complete solution of the generalized Killing-equations for flat spinning space and construct an infinite set of conserved charges. (author). 11 refs.

15643 (NIKHEF-H-90-14) **Simple WZW currents.** Fuchs, J. (Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H). Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. Aug 1990. 12p. Order Number DE91623521. Source: OSTI; NTIS (US Sales Only); INIS.

A complete classification of simple currents of WZW theory is obtained. The proof is based on an analysis of the quantum dimensions of the primary fields. Simple currents are precisely the primaries with unit quantum dimension; for WZW theories explicit formulae for the quantum dimensions can be derived so that an identification of the fields with unit quantum dimension is possible. (author). 19 refs.; 2 tabs.

15644 (OUP-90-29) **Magnetic fields around permanent magnets.** Yang, Z.J. Oslo Univ. (Norway). Fysisk Inst. Nov 1990. 11p. Order Number DE91623522. Source: OSTI; NTIS (US Sales Only); INIS.

The field distribution around permanent magnets with spherical and bar-like shapes homogenously polarized have been calculated. Based on these results several field profiles have been obtained by taking the limits. 2 refs., 2 figs.

15645 (OUP-90-31) **Recursive integral equations with positive kernel for lattice calculations.** Illuminati, F. (Oslo Univ. (Norway). Fysisk Inst.); Isopi, M. Oslo Univ. (Norway). Fysisk Inst. Nov 1990. 19p. Order Number DE91623523. Source: OSTI; NTIS (US Sales Only); INIS.

A Kirkwood-Salzburg integral equation, with positive defined kernel, for the states of lattice models of statistical mechanics and quantum field theory is derived. The equation is defined in the thermodynamic limit, and its iterative solution is convergent. Moreover, positivity leads to an exact a priori bound on the iteration. The equation's relevance as a reliable algorithm for lattice calculations is therefore suggested, and it is illustrated with a simple application. It should provide a viable alternative to Monte Carlo methods for models of statistical mechanics and lattice gauge theories. 10 refs.

15646 (OUP-90-34) **Vacuum currents around a magnetic fluxstring.** Flekkoey, E.G.; Leinaas, J.M. Oslo Univ. (Norway). Fysisk Inst. Dec 1990. 28p. Order Number DE91623524. Source: OSTI; NTIS (US Sales Only); INIS.

Vacuum polarization effects around a singular magnetic flux string in 2+1 and 3+1 dimensions have been examined. In particular charge and current densities and the flux induced by the vacuum current have been determined. The analysis is performed entirely on the basis of exact solutions to the pertinent Dirac equation. The 3+1 dimensional effects can be described in a simple way as a superposition of the 2+1 dimensional effects. 15 refs., 5 figs.

15647 (RAL-90-086) **New expressions for string loop amplitudes leading to an ultra-simple conception of string dynamics.** Chan Hongmo (Rutherford Appleton Lab., Chilton (UK)); Tsou Sheungtsun; Bordes, J.; Nelien, L. Rutherford Appleton Lab., Chilton (UK). Nov 1990. 39p. Order Number DE91623525. Source: OSTI; NTIS (US Sales Only); INIS.

New expressions are derived for string loop amplitudes as overlap integrals of string wave functionals. They are shown to take the form of exchange terms coming from the Bose-Einstein symmetrisation between string segments. One is thus led to the ultra-simple conception that string theory is basically free, and that 'string interactions' are due merely to the fact that strings are composite objects with Bose-Einstein segments as constituents. (author).

15648 (YITP/U-90-24) **The S-Matrix coupling dependence for a, d and e affine Toda field theory.** Braden, H.W. (Edinburgh Univ. (UK). Dept of Mathematics); Sasaki, R. Kyoto Univ., Uji (Japan). Yukawa Inst. for Theoretical Physics. Sep 1990. 14p. Order Number DE91768090. Source: OSTI; NTIS (US Sales Only); INIS.

Affine Toda field theories are solvable 1+1 dimensional quantum field theories closely related to integrable deformations of conformal field theory. The S-Matrix elements for an affine Toda field theory are known to depend on the coupling constant β through one universal function $B(\beta)$ which cannot be determined by unitarity, crossing and the bootstrap. From the requirement of nonexistence of extra poles in the physical region its form is conjectured to be $B(\beta) = (2\pi)^{-1}$center dot$\beta^2/((1+\beta^2)/4\pi)$. We show that the above conjecture is correct up to one loop order (i.e., β^4) of perturbation for simply laced, i.e., a, d and e affine Toda field theories using a general argument which exhibits much of the richness of these theories. (author).

15649 (YITP/U-90-25) **Multiple poles and other features of affine Toda field theory.** Braden, H.W. (Edinburgh Univ. (UK). Dept. of Mathematics); Corrigan, E.; Dorey, P.E.; Sasaki, R. Kyoto Univ., Uji (Japan). Yukawa Inst. for Theoretical Physics. Oct 1990.

33p. Order Number DE91768089. Source: OSTI; NTIS (US Sales Only); INIS.

Some perturbative features of affine Toda field theory are explored, in particular the mechanisms responsible for the first, second and third order poles in the conjectured exact factorisable S-matrices in the ADE series of models. It is found that generic collections of Feynman diagrams are responsible for the leading order poles in any of the theories. However, the complexity is such that it has not yet proved possible to analyse all the singularities that occur up to order twelve. Some comments are made on an associated tiling problem and on an interesting connection between the affine Toda couplings and the Clebsch-Gordan decomposition of tensor products. (author).

65 PHYSICS II

Refer also to citation(s) 15453, 15454, 15455, 15456, 15457, 15981, 15982

6510 Nuclear Physics

Refer also to citation(s) 15521, 15534, 15726, 15733, 15976, 15977, 16004, 16005, 16007, 16008, 16010, 16012, 16013, 16014, 16015, 16016, 16017, 16019

15650 (CEA-DPHN-90-1) **Nuclear Physics Department: Progress report from the 1st October 1988 to the 30th September 1990.** CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire. 1990. 187p. (In French). Order Number DE91767799. Source: OSTI; NTIS (US Sales Only).

The work performed at the Nuclear Physics Department, from the 1st October 1988 to the 30th September 1990, are summarized. The investigations are carried out in the fields of heavy ion physics, intermediate energy physics and accelerators using superconducting cavities. Theoretical and experimental studies accomplished in the following fields are included: hot nuclei, exotic nuclei, giant resonances, fission, inelastic scattering, electroproduction of pions, polarization of deuterons, central collisions.

15651 (DOE/ER/40162-T5) **Light particle emissions in heavy ion reactions: Progress report, June 1, 1990-May 31, 1991.** Petitt, G.A.; Liu, Xin-Tao; Smathers, J.; Zhang, Ziang. Georgia State Univ., Atlanta, GA (USA). Dept. of Physics and Astronomy. Mar 1991. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-84ER40162. Order Number DE91010746. Source: OSTI; NTIS; INIS; GPO Dep.

We are completing another successful year of experimental work at the Holifield Heavy Ion Research Facility (HHIRF), the Los Alamos white neutron source facility, Brookhaven National Laboratory (BNL) and Georgia State University (GSU). A paper on energy division between the two heavy fragments in deep inelastic reactions between ^{58}Ni + ^{165}Ho was published in Physical Review C during the year. We have partially completed analysis of the data on the ^{32}S + ^{93}Nb system taken with the HILI detector system at the HHIRF. This paper discusses work on these topics and discusses the setup of a neutron detector for a neutron reaction experiment.

15652 (DOE/ER/40376-4) **Microscopic heavy-ion theory: Progress report, February 1990-January 1991.** Oberacker, V.E.; Umar, A.S. Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy. [1991]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-87ER40376. Order Number DE91010739. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses the following topics: EM lepton pair production in relativistic HI collisions; string-parton model for RHI collisions; study of fission dynamics via muon-induced fission; mean-field studies with B-splines; the Basis-Spline collocation method; and relativistic generalization of the collective model.

15653 (GSI-91-03) **The discovery of nuclear compression phenomena in relativistic heavy-ion collisions.** Schmidt, H.R. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Jan 1991. 50p. Order Number DE91764932. Source: OSTI; NTIS (US Sales Only); INIS.

This article has attempted to review more than 15 years of research on shock compression phenomena, which is closely related to the goal of determining the nuclear EOS. Exciting progress has been made in this field over the last years and the fundamental physics of relativistic heavy ion-collisions has been well established. Overwhelming experimental evidence for the existence of shock compression has been extracted from the data. While early, inclusive measurements had been rather inconclusive, the advent of 4π-detectors like the GSI-LBL Plastic Ball had enabled the outstanding discovery of collective flow effects, as they were predicted by fluid-dynamical calculations. The particular case of conical Mach shock waves, anticipated for asymmetric collisions, has not been observed. What are the reasons? Surprisingly, the maximum energy of 2.1 GeV/nucleon for heavy ions at the BEVALAC had been found to be too low for Mach shock waves to occur. The small ^{20}Ne-nucleus is stopped in the heavy Au target. A Mach cone, however, if it had developed in the early stage of the collision will be wiped out by thermal motion in the process of slowing the projectile down to rest. A comparison of the data with models hints towards a rather hard EOS, although a soft one cannot be excluded definitively. A quantitative extraction is aggravated by a number in-medium and final-state effects which influence the calculated observables in a similar fashion as different choices of an EOS. Thus, as of now, the precise knowledge of the EOS of hot and dense matter is still an open question and needs further investigation. (orig.).

15654 (GSI-91-03(prepr.)) **Directions of heavy ion physics.** Kienle, P. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Jan 1991. 40p. (CONF-901277-: Yoshio Nishina centennial symposium on evolutional trends of physical sciences, Tokyo (Japan), 5-7 Dec 1990). Order Number DE91764670. Source: OSTI; NTIS (US Sales Only); INIS.

Recent progress and directions of heavy ion physics in various fields of nuclear atomic physics are presented. The progress in the acceleration technique in producing high energy high phase space density heavy ion beams in cooler storage rings is discussed. Studies of nuclei under extreme conditions address topics like the structure of nuclei at the border of nuclear stability including high spin states. Nuclear dynamics studies from the Coulomb-barrier to relativistic energies will be presented with a focus on the production of dense, heated and excited nuclear matter including the study of the properties of hadrons in such a medium particularly with respect to chiral symmetry restoration. Some atomic physics experiments with heavy ions will be addressed with emphasis on quasiatom and e^+e^- pair production. (orig.).

15655 (IAEA-NDS-10(Rev.2)) **ENDF/B format.** Khalil, M.A.; Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1986. 25p. Order Number DE91624088. Source: OSTI; NTIS (US Sales Only); INIS.

This document is a brief user's description of the format of ENDF/B. This format, originally designed for the US Evaluated Nuclear Data File, is recommended for international use. This summary is an aid to customers of the IAEA Nuclear Data Section when receiving data retrievals in ENDF/B format. For more detailed information the report BNL-NCS-50496 (ENDF 102) should be consulted. An Appendix to the present document gives a summary of the format differences between ENDF/B-4 and ENDF/B-5. (author).

15656 (IAEA-NDS-11(Rev.5)) **ENDL-84. The Evaluated Nuclear Data Library of the Lawrence Livermore National Laboratory in the ENDF-5 format: Contents and documentation.** Cullen, D.E.; McLaughlin, P.K.; Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1990. 47p. Order Number DE91624089. Source: OSTI; NTIS (US Sales Only); INIS.

This document summarizes the contents of the evaluated nuclear data library (ENDL) by the Lawrence Livermore National Laboratory, USA, converted to ENDF-5 format. The library contains evaluated data for all significant neutron reactions in the energy range from 10^{-4} eV to 20 MeV for 94 elements or isotopes. The

entire library or selective retrievals from it can be obtained on magnetic tape, free of charge, from the IAEA Nuclear Data Section. (author).

15657 (IAEA-NDS–18(Rev.4)) **JENDL-2 (Rev. 1). Japanese Evaluated Nuclear Data Library. Version 2 Rev. 1: Contents and documentation.** Pronyaev, V.G.; Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Nov 1986. 8p. Order Number DE91624095. Source: OSTI; NTIS (US Sales Only); INIS.

This document summarizes the contents of JENDL-2, the Japanese Evaluated Nuclear Data Library in ENDF/B-4 format. Copies of the data library or selective retrievals from it are available upon request costfree from the IAEA Nuclear Data Section. (author). 1 tab.

15658 (IAEA-NDS–21(Rev.4)) **KEDAK-4. Karlsruhe Evaluated Neutron Data Library: Brief summary of contents and format.** Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1986. 19p. Order Number DE91624096. Source: OSTI; NTIS (US Sales Only); INIS.

This summary is an aid to customers of the IAEA Nuclear Data Section when receiving data retrievals in KEDAK format. The KEDAK-4 Library or a selective retrieval from it is available costfree upon request. (author).

15659 (IAEA-NDS–64(Rev.0)) **GRINTACS. Thermal Neutron Activation Cross-Sections and Resonance-Integrals.** Gryntakis, E. (comp.). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Jan 1986. 66p. Order Number DE91624097. Source: OSTI; NTIS (US Sales Only); INIS.

This data compilation was included in the IAEA Handbook on Nuclear Activation Data (1986). The data file is also available on magnetic tape from the IAEA Nuclear Data Section. The tape is expected to be updated when new data become available. (author).

15660 (IAEA-NDS–68(Rev.0)) **RCN-2.CP. Evaluated neutron cross-section library for 13 corrosion products, cover-gas nuclides and other nuclides in the primary cooling circuit of a fast power reactor.** Gruppelaar, H. (Netherlands Energy Research Foundation, Petten (Netherlands)); Lemmel, H.D. (ed.). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Aug 1986. 15p. Order Number DE91624098. Source: OSTI; NTIS (US Sales Only); INIS.

This document summarizes the contents of the evaluated neutron cross-section library "RCN-2.CP" released in 1982 by the Netherlands Energy Research Foundation, ECN. - Upon request, this library is available on magnetic tape, in KEDAK format, from the IAEA Nuclear Data Section, costfree. (author).

15661 (IAEA-NDS–90(Rev.3)) **BROND. USSR Evaluated Neutron Data Library.** Manokhin, V.N. (and others). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1990. 20p. Order Number DE91624099. Source: OSTI; NTIS (US Sales Only); INIS.

Revised by Lemmel, H.D. and McLaughlin, P.K.

BROND, the USSR computerized data library for evaluated neutron reaction data was released in 1987/1990. Upon request it is available on magnetic tape, costfree, from the IAEA Nuclear Data Section. This document describes the contents of this library in the versions BROND-NDS1 and BROND-NDS2, BROND-NDS3, BROND-NDS4. (author). 16 refs.

15662 (IAEA-NDS–92(Rev.0)) **WIMKAL-88. The 1988 version of WIMS-KAERI Library: Summary Report.** Jung Do Kim (Korea Advanced Energy Research Inst., Daeduk (Republic of Korea)). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Aug 1990. 34p. Order Number DE91624100. Source: OSTI; NTIS (US Sales Only); INIS.

The WIMS-KAERI Library is a nuclear data library for thermal reactor neutronics calculations. It contains neutron reaction data in 69 groups of neutron energies for more than 130 materials. A magnetic tape copy of the library is available, free of charge. (author). 1 fig., 8 tabs.

15663 (IAEA-NDS–117(Rev.0)) **GAMCAT. Gamma and alpha rays from radioactive decay.** International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section; Fachinformationszentrum Karlsruhe, Gesellschaft fuer Wissenschaftlich-Technische Information mbH, Eggenstein-Leopoldshafen (Germany, F.R.). May 1990. 4p. Order Number DE91624090. Source: OSTI; NTIS (US Sales Only); INIS.

GAMCAT is a personal computer database on gamma and alpha rays from radioactive nuclei. The database is available from the Fachinformationszentrum Karlsruhe for a nominal sales price; it is not available from the IAEA. (author).

15664 (IAEA-NDS–118(Rev.0)) **The ENSDF radioactivity data base for IBM-PC and computer network access.** Ekstroem, P. (Lund Univ. (Sweden). Dept. of Nuclear Physics); Spanier, L. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Aug 1989. 11p. Order Number DE91624091. Source: OSTI; NTIS (US Sales Only); INIS.

A database for about 15000 gamma rays from 2777 radioactive nuclides derived from the international Evaluated Nuclear Structure Data File (ENSDF) is described together with supporting computer codes. The database is available on a PC diskette, costfree, from the IAEA Nuclear Data Section. (author).

15665 (IAEA-NDS–120(Rev.0)) **JEF-1. The evaluated nuclear data library of the NEA Data Bank: Summary of contents.** Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1990. 21p. Order Number DE91624092. Source: OSTI; NTIS (US Sales Only); INIS.

This document summarizes the contents of JEF-1, the Joint Evaluated File of nuclear data compiled by the OECD Nuclear Energy Agency Data Bank, finalized in 1986 and released in 1990. The entire library or retrievals of selected materials are available on magnetic tape from the IAEA Nuclear Data Section free of charge. (author).

15666 (IAEA-NDS–125(Rev.0)) **UENDL/NAA. USSR Evaluated Nuclear Data Library for Neutron Activation Analysis.** Pashchenko, A.B. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Nov 1990. 76p. Order Number DE91624093. Source: OSTI; NTIS (US Sales Only); INIS.

This document describes contents and format of the USSR Evaluated Nuclear Data library for Neutron Activation Analysis. It contains recommended values for activation cross-sections of 14.5 MeV energy neutrons and neutrons form U-235 and Cf-252 fission; for resonance integrals of capture, absorption and fission reactions; for thermal neutron capture and absorption reaction cross-sections; for effective resonance energy values; for the main gamma-ray energies of neutron capture and for their absolute intensities; for half-lives and abundance for all known nuclides. Upon request UENDL/NAA library package is available on a set of two low density PC diskettes from the IAEA Nuclear Data Section on a cost-free basis. (author). 4 refs, 2 tabs.

15667 (IAEA-NDS–141(Rev.0)) **The International Reactor Dosimetry File (IRDF-90).** Kocherov, N.P.; McLaughlin, P.K. (comps.). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Aug 1989. 55p. Order Number DE91624094. Source: OSTI; NTIS (US Sales Only); INIS.

This document describes the contents of the new version of the International Reactor Dosimetry File (IRDF-90) which contains recommended neutron cross-section data to be used for reactor neutron dosimetry by foil activation. It also contains selected recommended values for radiation damage cross-sections and benchmark neutron spectra. This library supersedes all earlier versions of IRDF. It is available on magnetic tape or on a set of PC diskettes from the IAEA Nuclear Data Section, costfree, upon request. (author). 3 refs, 1 tab.

15668 (INDC(CCP)–323/L) **Reaction cross-sections induced by 14.5 MeV and by Cf-252 and U-235 fission spectrum neutrons: An analytical review.** Pashchenko, A.B. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). Jan 1991. 59p. Translation of report FEI-0236 by A. Lorenz. (FEI–0236.). Order Number DE91624101. Source: OSTI; NTIS (US Sales Only); INIS.

Translation of report FEI-0236 by A. Lorenz.

The analytical review "Reaction Cross-Sections induced by 14.5 MeV Neutrons and by Cf-252 and U-235 Fission Spectrum Neutrons" presents evaluated values of threshold activation reaction cross-sections for stable nuclides induced by 14.5 MeV neutrons and by Cf-252 and U-235 fission spectrum neutrons. (author). 41 refs, tabs.

15669 (INDC(NDS)–238/L, pp. 9-19) **Gamma-ray production cross section measurements using a white neutron source from 1 to 400 MeV.** Wender, S.A. (Los Alamos National Lab., NM (USA)); Nelson, R.O.; Laymon, C.M. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). In *Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.* 194p. Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

The continuous energy (white) neutron source at the Los Alamos Meson Physics Facility (LAMPF) is used to measure photon-production cross sections over a wide range of neutron energies. Detector systems have been or are being developed to measure gamma rays in the energy range from hundreds of keV up to several hundreds of MeV. In particular a high resolution Ge detector system is used to detect gamma rays from several hundred keV to over 6 MeV. A 5 crystal BGO detector system is used for measuring gamma-rays from 1 MeV to approximately 20 MeV. A large volume BGO detector with an active shield is used to measure gamma rays in the range from 5 to 40 MeV. We are presently developing a multi-element gamma-ray telescope to measure gamma rays with energies from 50 MeV up to several hundred MeV. (author). 8 refs, 7 figs.

15670 (INIS-SU–236/A, pp. 63-75) **Isotopic dependence of radiative capture cross sections of intermediate and heavy mass nuclei at neutron energy of 0.5-2.0 MeV.** Trofimov, Yu.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 154p. (In Russian). In *Nuclear constants: Scientific-technical collection.* Order Number DE91003078. Source: OSTI; NTIS (US Sales Only); INIS.

Dependence of neutron radiation capture cross sections on the parameter of neutron excess of mean and heavy mass nuclei at 0.5-2 MeV neutron energy is ascertained on the base of the cross section exponential dependence on the reaction energy. An adequate description of experimental data on the nucleus neutron radiation capture cross sections by an isotopic dependence allows one to evaluate cross sections of ^{95,97}Nb, ^{105}Rh, ^{106}Ru, ^{111}Ag, ^{129,131}I, ^{132}Te, ^{135}Cs and ^{144}Ce nuclei-fission products difficult to be measured. Comparison to the data available is made. 16 refs.; 4 figs.; 1 tab.

15671 (ITEF–167-89) **Experimental testing of stationary cold nuclear fusion.** Danilov, M.M.; Zarubin, A.B.; Katarzhnov, Yu.D.; Kushin, V.V.; Nedopekin, V.G.; Nesterov, N.A.; Plotnikov, S.V.; Radkevich, I.A.; Rogov, V.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 8p. (In Russian). Order Number DE91624104. Source: OSTI; NTIS (US Sales Only); INIS.

Measurement results of the yield of neutrons which may result from fusion of deuterium nuclei during palladium sample saturation with deuterium under electrolysis conditions are given in the paper. The obtained results indicate absence of stationary cold nuclear fusion at $< 1.1 \times 10^{-24}$ neutron/s per one deuterium atom in sample and it essentially differs from data presented by other authors which managed to reach positive effect. Some sources of systematic error occurrence are indicated as well. 4 refs.; 2 figs.

15672 (LA-UR–91-3) **The file of evaluated decay data in ENDF/B.** Reich, C.W. (Idaho National Engineering Lab., Idaho Falls, ID (USA)); England, T.R. Los Alamos National Lab., NM (USA). [1991]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910603–3: Annual meeting of the American Nuclear Society (ANS), Orlando, FL (USA), 2-6 Jun 1991). Order Number DE91007348. Source: OSTI; NTIS; INIS; GPO Dep.

One important application of nuclear decay data is the Evaluated Nuclear Data File/B, the base of evaluated nuclear data used in reactor research and technology activities within the US. This report discusses the decay data file.

15673 (NIFS-DATA–9) **Partial and total electronic stopping cross sections of atoms and solids for protons.** Kaneko, Toshiaki. National Inst. for Fusion Science, Nagoya (Japan). Dec 1990. 111p. Order Number DE91767977. Source: OSTI; NTIS (US Sales Only); INIS.

Based on a wave packet theory (Phys. Rev. A40, 2188(1989); Phys. Stat. Sol. (B)156,49(1989)), partial and total electronic cross sections of target elements in atomic and solid phases with atomic number Z ranging from 2 (He) to 92 (U) are tabulated shell by shell for protons with velocity v from $0.2V_0$ to $2OV_0$ (V_0=2.18 x 10^8cm/s). (author).

6511 Experimental Techniques

Refer also to citation(s) 15780

15674 (ORNL/FTR–3879) **[Workshop on "Study of Nuclei with Neutrons"]: Foreign trip report, March 9–20, 1991.** Raman, S. Oak Ridge National Lab., TN (USA). 4 Apr 1991. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010242. Source: OSTI; NTIS; GPO Dep.

The traveler presented a progress report to Mr. T. Mukaiyama of the Japan Atomic Energy Research Institute (JAERI), Tokai Establishment, on work carried out at ORNL under the Japan/US Actinides Program. He developed a preliminary work plan for Japanese approval and funding during the ensuing Japanese fiscal year. He attended a workshop at Dubna, USSR, and visited the Institute of Physics at Obninsk, USSR.

6512 Nuclear Properties and Reactions, A = 1-5, Experimental

Refer also to citation(s) 15683

15675 (BONN-IR–90-57) **Deuteron electrofission in forward direction at a four-momentum transfer of Q^2=0.12 (GeV/c)^2.** Boden, B. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Dec 1990. 90p. (In German). Order Number DE91764652. Source: OSTI; NTIS (US Sales Only); INIS.

The deuteron electrodisintegration has been performed as the first experiment at the new Bonn 3.5 GeV high duty-cycle electron accelerator ELSA (Electron Stretcher and Accelerator). The cross section was measured in the region of the $\Delta(1232)$ resonance excitation at four-momentum-transfer of Q^2 = 0.12 (GeV/c)^2. An enhancement of the cross section has been observed at the mass of the NΔ system(W = 2.19 GeV) at each of the three hadron spectrometer angles Θ_p^{LAB} = 44^0, 56^0, 68^0 which were set. The results are compared with theoretical calculations. (orig.).

15676 (FRCEA-TH–326) **Experimental study of pions photoproduction and photodesintegration mechanisms on helium 3 in the Δ (1232) resonance region.** D'Hose, N. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire; Paris-11 Univ., 91 - Orsay (France). Jul 1988. 187p. (In French). Order Number DE91762837. Source: OSTI; NTIS (US Sales Only).

The goal of this work is the study in ^{3}He of the mechanisms involved in the absorption of photons in the $\Delta(1232)$ resonance region. One, two, or three nucleons participate in this absorption depending upon the specific reaction induced: pion photoproduction proceeds preferentially through absorption on a simple nucleon, whereas in photodesintegration without pion emission the photon is absorbed by few-nucleon subsystems. The experiments

were performed at the Saclay Linear Accelerator with the quasi-monochromatic in flight positron annihilation photon beam. Pion and proton spectra were measured using magnetic spectrometers for several angles from 20^0 to 72^0. Photon energies were in the 210-450 MeV range. For each kinematical setting a corresponding measurement of the reactions H($\gamma\pi^+$)n and D(γp)n allowed the comparison of the helium-3 cross sections to these more elementary ones. Our experimental results are compared to theoretical calculations utilizing realistic ^{3}He wave functions. Impulse approximation models which incorporate the nucleon Fermi motion cannot reproduce the pion coherent photoproduction ^{3}He($\gamma\pi^+$). The theoretical predictions of a charged pion quasi free photoproduction overestimate the experimental cross sections. For ^{3}He photodesintegration, without π production the calculations include short range correlations, mesonic exchange currents, and final state interactions. They agree reasonably well with the measured spectra in the region where absorption by a nucleon pair dominates, but they underestimate the cross section in the high momentum tip region.

15677 (IAEA-NDS–86(Rev.0)) **The AEP Barnbook DATLIB. Nuclear Reaction Cross Sections and Reactivity Parameter Library and Files.** Feldbacher, R. (Technische Univ., Graz (Austria). Inst. fuer Theoretische Physik und Reaktorphysik). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Oct 1987. 148p. Contract IAEA-4082/RB. (INDC(AUS)–12/G(Ver.1).). Order Number DE91624106. Source: OSTI; NTIS (US Sales Only); INIS.

Nuclear reaction data for light isotope charged particle reactions (Z<6) have been compiled. This hardcopy contains file headers, plots and an extended bibliography. Numerical data files and processing routines are available on tape at IAEA-NDS. (author). Refs.

15678 (IAEA-NDS–87(Rev.2)) **DROSG-87: Neutron Source Reactions. Version 1990. Angular dependences of neutron energies, cross sections and neutron yields for 13 monoenergetic neutron source reactions.** Drosg, M. (Vienna Univ. (Austria). Inst. fuer Experimentalphysik); Schwerer, O. (ed.). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Nov 1990. 2p. Order Number DE91624107. Source: OSTI; NTIS (US Sales Only); INIS.

This data file contains evaluated Legendre coefficients for the neutron source reactions H-1(t,n)He-3, H-1(Li-7,n)Be-7, H-1(B-11,n)C-11, H-1(C-13,n)N-13, H-1(N-15,n)O-15, H-2(d,n)He-3, H-2(t,n)He-4, H-3(p,n)He-3, H-3(d,n)He-4, Li-7(p,n)Be-7, B-11(p,n)C-11, C-13(p,n)N-13 and N-15(p,n)O-15. The diskette also contains a FORTRAN program calculating neutron energies and differential cross sections from the coefficients as well as neutron yields using energy-loss tables which are also provided. The data are available costfree from the IAEA Nuclear Data Section on 5.25 inch or 3.5 inch DOS formatted (IBM standard) diskette. (author).

15679 (INS–855) **Pion-transfer (n,d) and (d, ^{3}He) reactions leading to deeply bound pionic atoms.** Toki, H. (Tokyo Metropolitan Univ. (Japan). Dept. of Physics); Hirenzaki, S.; Yamazaki, T. Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study. Nov 1990. 34p. Order Number DE91767893. Source: OSTI; NTIS (US Sales Only); INIS.

Theoretical studies are given on the (n,d) and (d, ^{3}He) reactions leading to deeply bound pionic atoms in heavy nuclei of configuration [(nl)$_\pi$center dotj_n^{-1}]J. The cross sections for various pionic and neutron-hole configurations in the case of a ^{208}Pb target are calculated at incident energies 300-1000 MeV/u by using the effective number approach and the eikonal approximation for distortion. The effective number with a pion in the 1s or 2p state and a neutron hole in the $i_{13/2}$ orbit peaks around the same incident energy (T_n=600 MeV) as the elementary cross section n+n->d+π^-, where the momentum transfer matches the angular-momentum transfer of L=5~7. The DWIA cross section for (n,d) producing a pion in the 1s or 2p orbit at T_n=600 MeV is found to be around 42 or 75 μb/sr, respectively. At T_n=350 MeV, where the momentum transfer is small, quasi-substitutional states of configurations [$(2p)_\pi(3p_{1/2})_n^{-1}$]L=0 and [$(2p)_\pi(3p_{3/2})_n^{-1}$]L=0 are preferentially populated with cross sections of 190 and 380 μb/sr, respectively. The (d, ^{3}He) cross sections are estimated to be an order of magnitude smaller than the (n,d) cross sections. Thus, the (n,d) and (d, ^{3}He) reactions are found to be suited for the production of deeply bound pionic atoms. (author).

15680 (ITEF–117-89) **Search for double-charged anomalons in ^{3}Hep interactions at ^{3}He nucleus momentum of 5 GeV/c.** Abdullin, S.K. (and others); Blinov, A.V.; Vanyushin, I.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 8p. (In Russian). Order Number DE91624108. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental data are obtained using 80 cm liquid helium bubble chamber exposed in ^{3}He nuclei separated beam with momentum of 5 GeV/c. The present statistics presents no indications to existence of double-charged anomalons in p^{3}He interactions, the proton kinetic energy being $T_{p_{in}} \simeq 1$ GeV. It is shown that one of most probable methodical errors may cause imitation of anomalously small mean free paths. 8 refs.; 2 figs.

15681 (ITEF–159-89) **Study on the ^{3}Hp→dppπ^- at 5 GeV/c momentum in total phase space.** Abdullin, S.K. (and others); Blinov, A.V.; Vanyushin, I.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 12p. (In Russian). Order Number DE91624109. Source: OSTI; NTIS (US Sales Only); INIS.

ITEP liquid-hydrogen chamber 80cm in diameter, exposed to separated ^{3}H nucleus beams with 5 GeV/c momentum, was used to study for the first time the ^{3}Hp→dppπ^- reaction. 1060 events of such reaction were selected; this corresponds to 2.12±0.06 mbn cross section. Study of angular, mass and momentum spectra was conducted on the basis of the pole model in total phase space. Production of two- and three-baryon resonances were not suggested in studied reaction. 17 refs.; 4 figs.

15682 (UCID–18987-91) **Report to the DOE Nuclear Data Committee, 1991.** Resler, D.A.; White, R.M. Lawrence Livermore National Lab., CA (USA). Mar 1991. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91010909. Source: OSTI; NTIS; INIS; GPO Dep.

This document provides a discussion of charged-particle evaluations for applications; advanced modeling of reaction cross sections for light nuclei; thermonuclear data file (TDF) – a processed file for thermonuclear applications; evaluation of (n,2n) reactions on isotopes of Y and Zr; extension of the LLNL evaluated nuclear database (ENDL) to 30 MeV; and calculated kerma values. (LSP)

6513 Nuclear Properties and Reactions, A = 6-19, Experimental

Refer also to citation(s) 15677, 15678, 15747

15683 (IAEA-NDS–88(Rev.2)) **ENDF/B-6 Standards Library: Summary of contents and documentation.** Lemmel, H.D.; McLaughlin, P.K. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Nov 1990. 27p. Order Number DE91624111. Source: OSTI; NTIS (US Sales Only); INIS.

The ENDF/B-6 Standards Library includes evaluated data for seven neutron reactions that are internationally recommended as reference standards for nuclear measurements. The reactions are H-1,(n,n), He-3(n,p), Li-6(n,t), B-10(n,α), C(n,n), Au(n,γ), U-235(n,f). The data are available on magnetic tape from the IAEA Nuclear Data Section, free of charge. (author).

15684 (IPNO-DRE–9009) **Observation of the forward neutrons from the break-up of the ^{11}Li neutron halo.** Anne, R. (Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (FR)); Lewitowicz, M.; Saint-Laurent, M.G.; Arnell, S.E.; Jonson, B.; Mattsson, S.; Nyman, G.; Wilhelmsen, K.; Emling, H.; Hansen, P.G.; Johannsen, L.; Riisager, K.; Neugart, R.; RichteParis-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1990. 16p. Contract 06DA 184 I. Order Number DE91767803. Source: OSTI; NTIS (US Sales Only).

The cross-sections and forward angular distributions of fast neutrons have been studied for the reaction (^{11}Li, ^{9}Li) at 29 MeV/u on

targets of Be, Ni and Au. The cross-sections are large and arise essentially from peripheral reactions: Coulomb dissociation for the gold target, absorption and diffraction dissociation for the beryllium target. The angular distributions of the neutrons are almost identical for the three targets and very narrow; the half angle is $(2.9 +- 0.4)^0$. All evidence is consistent with the existence of a neutron halo with radius of about 12 fm.

15685 (LUNFD6-NFFK–1002-SE) **Inclusive and coincidence measurements of light particles and fragments from intermediate energy heavy ion collisions.** Westenius, M. Lund Univ. (Sweden). Dept. of Cosmic and Subatomic Physics. Oct 1990. 55p. Order Number DE91625471. Source: OSTI; NTIS (US Sales Only); INIS.

Intermediate energy heavy ion collisions have been studied. Presented data on light particles (ZETA=1,2) emitted in ^{12}C +C, Al, Cu, Au reactions at 35A and 85A MeV incident projectile energy are generally well described within the participant-spectator picture. When coincident light particles are measured, an excess of particles detected with (Δphi = 180 degrees) is found. The strength of this excess increases with the mass of the coincident particles and decreases with the mass of the target. These observation seem to be consistent with particle emission from a participant region where momentum conservation within this region causes the observed behaviour. Azimuthal angular distributions of projectile-like fragments detected in coincidence with light particles are consistent with a transverse momentum balance between the fragment and a participant source. Low-energy (1A-6A MeV) medium-heavy (ZETA=3-12) fragment emitted in 94A MeV ^{16}O+ Al collisions have been measured using ΔE-E telescopes consisting of silicon detectors implanted with boron. The momentum distributions of these fragments indicate the existence of two emission components. In addition to a component, which is isotropic in a system shifted by parallel- and transverse momenta ~ 15A MeV/c, another component with larger momentum shifts is needed to describe the results. (author).

6514 Nuclear Properties and Reactions, A = 20-38, Experimental

15686 (INDC(NDS)–238/L, pp. 149-186) **Evaluation of discrete γ ray production cross sections in (n,xγ) reactions on Al for nuclear geophysics.** Oblozinsky, P.; Hlavac, S. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). In *Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.* 194p. Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

We develop a set of recommended γ production cross sections in neutron reactions on aluminium for use in applied nuclear geophysics. This is achieved by analysis of existing experimental, theoretical, and evaluated production cross sections of discrete γ rays in (n,xγ) reactions on Al, in the incident neutron energy range from threshold up to 20 MeV. 36 refs, 13 figs, 9 tabs.

15687 (INIS-SU–236/A, pp. 101-105) **Experimental determination of the $^{27}Al(n,\alpha)^{24}Na$ reaction cross section at neutron energy of 14.8 MeV.** Moiseev, N.N.; Ramendik, Z.A.; Shchebolev, V.T. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 154p. (In Russian). In *Nuclear constants: Scientific-technical collection.* Order Number DE91003078. Source: OSTI; NTIS (US Sales Only); INIS.

Reported at the 1.International conference on neutron physics, Kiev(UA), 21-25 Sep 1987.

Cross section of $^{27}Al(n,\alpha)^{24}Na$ reaction was measured by activation method at neutron energy of 14.8 MeV. Its value was obtained being equal to (110±2) mb. Neutron fluence rate was measured with an uncertainty of less than 1%. Measurement of induced activity was carried out by beta-gamma-coincidence method and by scintillation gamma-spectrometer. 8 refs.; 1 tab.

15688 (IPNO-DRE–9005) **Production of and experiments with secondary radioactive beams.** Mueller, A.C. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1990. 12p. (CONF-9004248–: 2. IN2-P3-RIKEN symposium on heavy-ion collisions, Obernai (France), 9-13 Apr 1990). Order Number DE91767791. Source: OSTI; NTIS (US Sales Only).

Examples of recent experiments performed at the doubly achromatic spectrometer LISE are used to highlight the present-day interest in secondary radioactive beams and to point to some future experimental possibilities.

15689 (LIYaF–1557) **Search for correlated groups of particles produced in interactions of neon-22 relativistic nuclei with nuclei in photoemulsion at 4.1 A GeV/c momentum.** Lepekhin, F.G.; Simonov, B.B. AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki. 1989. 14p. (In Russian). Order Number DE91624117. Source: OSTI; NTIS (US Sales Only); INIS.

An analysis of collisions of relativistic neon-22 nucleus in nuclear emulsion at 4.1 A GeV/c is carried out to observe jets of produced particles genetically bound, correlated groups of single-charged relativistic particles of the event. Search for these groups was done by means of the algorithm in which the probability of the appearance of a group of particles in the separate event is estimated on measured values of polar and azimuthal angles of particles. The individual events containing groups of 2,3 and 4 particles with probability of random production less than 10^{-8} are identified. These events comprise about 5% from all inelastic interactions of relativistic neon 22 nucleus in nuclear emulsion. 22 refs.; 2 tabs.

15690 (OUP–90-28) **Anomalous emission of glueball candidates in the reaction anti p + Neon at 607 MeV/c incident momentum: CERN project PS-179.** Breivik, F.O. (Oslo Univ. (Norway). Fysisk Inst.); Haatuft, A.; Halsteinslid, A. LEAR Collaboration. Oslo Univ. (Norway). Fysisk Inst. Nov 1990. 15p. Order Number DE91625472. Source: OSTI; NTIS (US Sales Only); INIS.

Two narrow peaks at about 1450 and 1800 MeV/c^2 are seen in the distribution of invariant mass of the assumed six-pion systems in the final states of anti pNe-reactions at 607 MeV/c incident momentum. These systems are emitted also in the backward direction in the laboratory system with momenta near the momentum of the incident antiproton. This observation and the small widths suggest that the peaks are not due to well known baryons or mesons belonging to any Regge-trajectory. The peaks could possibly be due to glueball production. 12 refs., 4 figs.

6515 Nuclear Properties and Reactions, A = 39-58, Experimental

15691 (INDC(NDS)–238/L, pp. 21-30) **Measurements of γ-ray production from $^{52}Cr(n,x\gamma)$ reactions at 14.6 MeV.** Hlavac, S. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Fyzikalny Ustav); Oblozinsky, P. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). In *Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.* 194p. Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

Highly enriched sample of ^{52}Cr was irradiated by 14.6 MeV neutrons. Measured were discrete γ ray production cross section, total γ ray spectrum as well as coincident data such as average γ ray multiplicities. (author). 11 refs, 4 figs, 2 tabs.

6516 Nuclear Properties and Reactions, A = 59-89, Experimental

Refer also to citation(s) 15682, 15685

15692 (INIS-SU-236/A, pp. 117-124) **Measurement and evaluation of the averaged cross sections for the $^{64}Zn(n,p)^{64}Cu$, $^{90}Zr(n,2n)^{89}Zr$, $^{111}Cd(n,n')^{111m}Cd$ reactions for the ^{235}U fission neutrons.** Grigor'ev, E.I.; Melekhin, Yu.A.; Troshin, V.S.; Yaryna, V.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 154p. (In Russian). In *Nuclear constants: Scientific-technical collection.* Order Number DE91003078. Source: OSTI; NTIS (US Sales Only); INIS.

Averaged cross sections for $^{64}Zn(n,p)^{64}Cu$, $^{90}Zr(n,2n)^{89}Zr$, $^{111}Cd(n,n')^{111m}Cd$ were measured for ^{235}U fission neutron spectrum. These results are 34.4±0.8 mb, 0.0945±0.045 mb, 198±4 mb respectively. The emission of the photons with 0.52 MeV for ^{64}Cu was used 0.343. Evaluated cross sections are 33.8±0.7 mb and 0.0966±0.0024 mb for Zn and Zr. There are not the publication for Cd therefore the evaluation was not made. 12 refs.; 6 tabs.

6517 Nuclear Properties and Reactions, A = 90-149, Experimental

Refer also to citation(s) 15486, 15682, 15692, 15735

15693 (CRN-PN-9012) **Superdeformation at and above the Yrast.** Vivien, J.P. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1990. 14p. (CONF-9004248-: 2. IN2-P3-RIKEN symposium on heavy-ion collisions, Obernai (France), 9-13 Apr 1990). Order Number DE91767814. Source: OSTI; NTIS (US Sales Only).

The decay of the lowest energy superdeformed band has now been established for a number of nuclei near A = 150, confirming predictions that these superdeformed nuclei exist. Multiple superdeformed bands found in a few of these nuclei in conjunction with studies of the superdeformed bands in the γ-ray continuum give some insight into the feeding and desexcitation process as a funtion of excitation energy above the yrast line. These are the first premises of a nuclear spectroscopy in the superdeformed minimum, one of the principle aims of the future 4π γ-ray detection equipments.

15694 (IAEA-NDS-67(Rev.0)) **RCN-3. Evaluated Fission-Product Cross-Section Library.** Gruppelaar, H. (Netherlands Energy Research Foundation, Petten (Netherlands)); Lemmel, H.D. (ed.). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Aug 1986. 48p. Order Number DE91624127. Source: OSTI; NTIS (US Sales Only); INIS.

This document summarizes the contents of the Evaluated Fission-Product Cross-Section Library RCN-3 released in 1983 by the Netherlands Energy Research Foundation, ECN, and those parts of the earlier version of RCN-2 that were not superseded by RCN-3. Upon request the Library is available on magnetic tape from the IAEA Nuclear Data Section, costfree. (author).

15695 (INIS-SU-236/A, pp. 51-62) **Joint evaluation of level excitation functions and γ-spectra in inelastic neutron scattering on ^{93}Nb.** Pronyaev, V.G.; Belanova, T.S.; Elokhin, A.I.; Ignatyuk, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 154p. (In Russian). In *Nuclear constants: Scientific-technical collection.* Order Number DE91003078. Source: OSTI; NTIS (US Sales Only); INIS.

Revision of ^{93}Nb evaluated neutron cross section file for the BROND library is performed. The new file option comprises revised functions of inelastic scattering excitation levels, energy-angular distributions of secondary neutrons, γ-quantum spectra and production cross sections. The evaluation is performed within the framework of optico-statistic approach (functions of level excitation under inelastic scattering, secondary neutron energy-angular distributions) or analysis of experimental data (γ-ray yield cross sections and γ-quantum spectra).The analysis results are used when forming a new option of ^{93}Nb file for the BROND evaluated neutron cross section library. 42 refs.; 6 figs.; 1 tab.

15696 (ITEF-125-89) **Search for 2β decay of ^{116}Cd to first excited state of ^{116}Sn.** Barabash, A.S.; Kopylov, A.V.; Cherekhovskij, V.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 11p. (In Russian). Order Number DE91624129. Source: OSTI; NTIS (US Sales Only); INIS.

Limits for 2β decay of ^{116}Cd to the first excited state of ^{116}Sn is obtained: $T_{1/2}(0\nu+2\nu;0^+\text{-}2^+) \geq 4\times10^{19}$ yr. by means of low-background semiconductor gamma spectrometer. The limits for 2β decay of ^{116}Cd into excited ^{116}Sn states at 2112.2 (2_1^+) and 2225.3 keV (2_2^+) are obtained too ($T_{1/2}(0\nu+2\nu)>1.7\times10^{20}$ yr. and $>1.0\times10^{20}$ yr. respectively. 17 refs.; 3 figs.

15697 (ITEP-151-89) **Concerning possibility of search for $k\beta^+$ decay of ^{124}Xe.** Obodovskij, I.; Shchepkin, M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 8p. Order Number DE91624130. Source: OSTI; NTIS (US Sales Only); INIS.

The estimates of probabilities of $K\beta^+(0\nu)$ and $K\beta^+(2\nu)$ decays of ^{124}Xe are given. Possibility of experimental search for these decays are briefly discussed. 13 refs.

6518 Nuclear Properties and Reactions, A = 150-189, Experimental

Refer also to citation(s) 15694

15698 (GSI-90-73(prepr.)) **Triaxiality and γ-softness in the A $\simeq$ 190 mass region.** Wollersheim, H.J. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Dec 1990. 15p. (CONF-9009135-: International conference on high spin physics and gamma-soft nuclei, Pittsburgh, PA (USA), 17-21 Sep 1990). Order Number DE91764565. Source: OSTI; NTIS (US Sales Only); INIS.

The nuclear level structure and electromagnetic properties of $^{182,184,186}W$, ^{196}Pt and $^{198,200,202,204}Hg$ were investigated with γ-spectroscopic techniques using multiple Coulomb excitation by ^{208}Pb projectiles. E2 transition moments and spectroscopic quadrupole moments have been determined by a comparison of experimental scattering-angle dependent γ yields with calculated yields in a largely model-independent procedure. The results are compared with the rigid and soft asymmetric rotor model. From such a comparison the collective properties can be determined which permit to differentiate between various quadrupole shape parameters. The experimental results are discussed in particular with respect to the rigidity or softness in the γ-degree of freedom. The results for the isotopes ^{184}W and ^{186}W are consistent with an axially symmetric deformation. In contrast, the ^{182}W isotope exhibits a non-axial deformation together with an unexpected shape change at spin I=10$^+\hbar$. In case of ^{196}Pt the experimental data show both the characteristics for triaxiality and γ softness. The energies and B(E2) values of the ground state band in the Hg isotopes are well reproduced by the soft triaxial-rotor model. The relative B(E2) values show that the rapid shrinking of the collective configuration space made up by proton and neutron holes with respect to the Z=82 and N=126 major shells is not observed in experiment. (orig.).

6519 Nuclear Properties and Reactions, A = 190-219, Experimental

Refer also to citation(s) 15174, 15486, 15683, 15698

15699 (CEA-LNS-PH-91-02) **Investigation of nuclear multifragmentation using molecular dynamics and restructured aggregation.** Paula, L. de (Laboratoire National Saturne, Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (FR)); Nemeth, J.; Ben-Hao, Sa.; Leray, S.; Ngo, C.; Souza, S.R.; Yu-Ming, Zheng; Paula, L. de; Nemeth, J.; Ben-Hao, Sa.; Yu-Ming, Zheng; Ngo; H. Laboratoire National Saturne - Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). 1991. 17p. (CONF-910111-: 14. international winter meeting on nuclear physics, Bormio (Italy),

21-25 Jan 1991). Order Number DE91767713. Source: OSTI; NTIS (US Sales Only).

We study the stability of excited ^{197} Au nuclei with respect to multifragmentation. For that we use a dynamical simulation based on molecular dynamics and restructured aggregation. A particular attention is paid to check the stability of the ground state nuclei generated by the simulation. Four kinds of excitations are considered: heat, compression, rotation and a geometrical instability created when a projectile drills a hole in a ^{197} Au nucleus.

15700 (GSI–91-08(prepr.)) **Intermediate mass fragments from ^{40}Ar+^{197}Au: Transition from the incomplete fusion to the participant spectator regime.** Milkau, U. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.)); Berdermann, E.; Hildenbrand, K.D.; Hubele, J.; Kunde, G.J.; Lynen, U.; Mueller, W.F.J.; Rabe, H.J.; Sann, H.; Stelzer, H.; Trautmann, W.; Trockel, R.; Berthier, B.; BouissoGesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Jan 1991. 14p. Order Number DE91764946. Source: OSTI; NTIS (US Sales Only); INIS.

Inclusive cross sections of intermediate mass fragments from the reaction ^{40}Ar+^{197}Au at E/A=30 MeV and 220 MeV were measured with a low threshold and over a large range of angles. The integrated cross sections are about 2 b at both energies but the emission characteristics change considerably. The increased isotropy of the angular distributions and the strongly reduced Coulomb repulsion at the higher bombarding energy suggest that the emission process evolves towards fragmentation of excited spectator matter in central ion-ion collisions. (orig.).

15701 (INIS-SU–236/A, pp. 131-144) **Investigation of the ^{204}Pb γ-radiation in the (n,n'γ) reaction.** Demidov, A.M.; Mikhajlov, I.V.; Cherepantsev, Yu.K. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 154p. (In Russian). In *Nuclear constants: Scientific-technical collection.* Order Number DE91003078. Source: OSTI; NTIS (US Sales Only); INIS.

Gamma-spectrum, angular distributions and linear polarization of the ^{204}Pb γ-quanta in the (n,n'γ) reaction were measured using reactor fast neutrons. The γ-transition scheme of ^{204}Pb has been constructed. The multipole mixing parameters δ for the γ-transitions between the low-lying levels have been found. 9 refs.; 4 tabs.

6520 Nuclear Properties and Reactions, A = 220 and Above, Experimental

Refer also to citation(s) 15683, 15769

15702 (IAE–4829-2) **Probability of isomeric ^{235}U nuclei production in nearsurface laser plasma.** Arutyunyan, R.V. (and others); Dolgov, V.A.; Dorshakov, S.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 13p. (In Russian). Order Number DE91624165. Source: OSTI; NTIS (US Sales Only); INIS.

Possible mechanisms of the 76.8 eV isomeric level excitation of ^{235}U nucleus in a laser produced plasma are considered. The preliminary experiments results of the intensive CO_2-laser beam interaction with the uranium oxide surface are given. The attempt to detect the production of ^{235}U isomers with $T_{1/2}$=26 min in the laser produced surface plasma was unsuccessful. The reasons of negative result are discussed. 21 refs.; 2 figs.

15703 (IAEA-NDS–13(Rev.5)) **ENDF/B-5 Actinides (Rev. 86).** Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. May 1986. 133p. Order Number DE91624167. Source: OSTI; NTIS (US Sales Only); INIS.

This document summarizes the contents of the Actinides part of the ENDF/B-5 nuclear data library released by the US National Nuclear Data Center. This library or selective retrievals of it, are available costfree from the IAEA Nuclear Data Section upon request. The present version of the library is the Revision of 1986. (author). Refs, figs and tabs.

15704 (IAEA-NDS–62(Rev.0)) **ENDF/B-5. Fission Product Yields File: Summary Documentation of contents and format.** Schwerer, O. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Oct 1985. 7p. Order Number DE91624168. Source: OSTI; NTIS (US Sales Only); INIS.

The ENDF/B-5 Fission Product Yields File contains a complete set of independent and cumulative fission product yields, representing the final data from ENDF/B-5 as received at the IAEA Nuclear Data Section in June 1985. Yields for 11 fissioning nuclides at one or more neutron incident energies are included. The data are available costfree on magnetic tape from the IAEA Nuclear Data Section. (author). 4 refs.

15705 (IAEA-NDS–91(Rev.0)) **Chinese Evaluated Fission-Product Yield Library 1987 (preliminary).** Wang Dao (Academia Sinica, Beijing, BJ (China). Inst. of Atomic Energy); Zhang Dongming; Lemmel, H.D. (ed.). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Oct 1987. 32p. Order Number DE91624169. Source: OSTI; NTIS (US Sales Only); INIS.

The 1987 version of the Chinese evaluated data library for fission-product yields contains data in ENDF-5 format for 10 fissioning systems of U-235, U-238, Pu-239, Pu-241, U-233, Th-232. The data library on magnetic tape is available, costfree, from the IAEA Nuclear Data Section. (author). 25 refs, 4 figs, 10 tabs.

15706 (IAEA-NDS–98(Rev.1)) **Cf-252 neutron spectrum.** Lemmel, H.D. (ed.). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Dec 1987. 44p. Order Number DE91624170. Source: OSTI; NTIS (US Sales Only); INIS.

The californium-252 spontaneous fission neutron spectrum evaluated by W. Mannhart, PTB Braunschweig, Federal Republic of Germany, is documented. The numerical data are available on magnetic tape, costfree, from the IAEA Nuclear Data Section. (author). Refs, figs and tabs.

15707 (IAEA-NDS–123(Rev.0)) **JEF-1 Fission Product Yield Data: Brief summary of contents.** Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1990. 1p. Order Number DE91624166. Source: OSTI; NTIS (US Sales Only); INIS.

This document gives a brief documentation of the JEF-1 Fission Product Yield Data library which is available from the IAEA Nuclear Data Section on magnetic tape, free of charge. (author).

15708 (INDC(CCP)–322/L, pp. 13-19) **Re-evaluation of the resonance parameters of ^{241}Pu.** Morogovskij, G.B. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Dec 1990. Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-310/G. In *Translation of selected papers published in Yademye Konstanty (Nuclear Constants 3, 1988).* 19p. Order Number DE91623087. Source: OSTI; NTIS (US Sales Only); INIS.

Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-310/G.

The data for ^{241}Pu in the resolved resonance region are re-evaluated using the new available data on the σ_γ cross-section. 15 refs.

15709 (INDC(NDS)–238/L, pp. 31-36) **Prompt γ-rays from ^{232}Th, ^{236}U, and ^{238}U fission fragments.** Filatenkov, A.A. (Radievyj Inst., Leningrad (USSR)); Chuvaev, S.V. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). In *Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.* 194p. Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

An analysis of spectra of prompt γ-rays emitted at the ^{232}Th, ^{235}U, and ^{238}U fission induced by 3 MeV and 15 MeV neutrons is presented. Energies and yields of about 30 γ-transitions have been determined in the time interval of 25 ns. An availability of the method used is discussed for investigation of the induced fission and for obtaining of the spectroscopic information on nuclei laying far from the beta-stability valley. (author). 11 refs, 3 figs, 1 tab.

15710 (INIS-SU–236/A, pp. 106-116) **Analysis of prompt neutron spectrum of plutonium-239 nucleus fission.** Sukhikh, S.Eh.; Lovchikova, G.N.; Vinogradov, V.A.; Zhuravlev, B.V.; Polyakov, A.V.; Sal'nikov, O.A.; Merten, Kh.; Ruben, A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 154p. (In Russian). In *Nuclear constants: Scientific-technical collection.* Order Number DE91003078. Source: OSTI; NTIS (US Sales Only); INIS.

The prompt fission neutron spectra from ^{239}Pu neutron-induced fission has been measured at incident neutron energy 1.49±0.04 MeV. The measurements were carried out by means of time-of-flight technique with pulsed-beam proton tandem accelerator and tritium gas target as a neutron source. The spectra were measured at two angles 90 deg and 150 deg to incident neutron beam. The suing of the ^{252}Cf prompt neutron fission spectrum as a standard for the neutron detector efficiency calibration allowed to minimize influence of collimator channel zone and to avoid the spectrometer time scale calibration uncertainties. The experimental results were compared with generalized Madland-Nix model calculations of prompt fission neutron spectra. The results of the calculations are in a satisfactory agreement with an experimental results. 21 refs.; 3 figs.; 1 tab.

15711 (INIS-SU–236/A, pp. 125-130) **Two-dimensional method for delayed neutron spectra measuring.** Maksyutenko, B.P.; Balakshev, Yu.F.; Ignat'ev, S.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 154p. (In Russian). In *Nuclear constants: Scientific-technical collection.* Order Number DE91003078. Source: OSTI; NTIS (US Sales Only); INIS.

The delayed-neutron spectra of four groups for U-235 thermal neutron fission were reconstructed from experimental information obtained by two-dimensional method. The average energies of spectra and relative yields were calculated. Some possibilities of the two-dimensional method were pointed to control the obtained results, which were compared with data of other authors. 5 refs.; 6 figs.; 1 tab.

15712 (LBL–29357) **In-beam studies of high-spin states of actinide nuclei.** Stoyer, M.A. (Lawrence Berkeley Lab., CA (USA). Nuclear Science Div.). Lawrence Berkeley Lab., CA (USA). 15 Nov 1990. 216p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91009675. Source: OSTI; NTIS; INIS; GPO Dep.

High-spin states in the actinides have been studied using Coulomb- excitation, inelastic excitation reactions, and one-neutron transfer reactions. Experimental data are presented for states in ^{232}U, ^{233}U, ^{234}U, ^{235}U, ^{238}Pu and ^{239}Pu from a variety of reactions. Energy levels, moments-of-inertia, aligned angular momentum, Routhians, gamma-ray intensities, and cross-sections are presented for most cases. Additional spectroscopic information (magnetic moments, M_1/E_2 mixing ratios, and g-factors) is presented for ^{233}U. One- and two-neutron transfer reaction mechanisms and the possibility of band crossings (backbending) are discussed. A discussion of odd-A band fitting and Cranking calculations is presented to aid in the interpretation of rotational energy levels and alignment. In addition, several theoretical calculations of rotational populations for inelastic excitation and neutron transfer are compared to the data. Intratheory comparisons between the Sudden Approximation, Semi-Classical, and Alder-Winther-DeBoer methods are made. In connection with the theory development, the possible signature for the nuclear SQUID effect is discussed. 98 refs., 61 figs., 21 tabs.

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Refer also to citation(s) 14576, 15550, 15610, 15650, 15653, 15670, 15688, 15693, 15770

15713 (CSNSM–8959) **Significancy in atomic mass measurements and the topography of the mass - surface.** Audi, G. Paris-11 Univ., 91 - Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse. 1990. 16p. (CONF-8911216–: Workshop on the contribution to the nuclear structure of light nuclei far from stability experiment and theory workshop, Overnai (France), 27-29 Nov 1989). Order Number DE91767819. Source: OSTI; NTIS (US Sales Only).

The chart of the nuclides for light nuclei showing the results obtained at GANIL is analyzed. Some aspects of the need for mass measurements are discussed. The basic principles involving a significant mass measurement are explained. The results of the two - neutron separation energies S2n for some elements between z = 52 and z = 63, for odd - nuclei and in the region including the new magic N=15 are provided. The study shows that the mass surface can reveal some properties of the nuclei.

15714 (DOE/ER/40365–4) **Theoretical studies in medium-energy nuclear and hadronic physics: Annual technical progress report, April 1, 1990–March 31, 1991.** Horowitz, C.J.; Macfarlane, M.H.; Serot, B.D. Indiana Univ., Bloomington, IN (USA). Dept. of Physics. [1991]. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-87ER40365. Order Number DE91010265. Source: OSTI; NTIS; INIS; GPO Dep.

In the period covered by this report, work focused on five main areas: relativistic theories of nuclear structure and saturation; relativistic descriptions of proton-nucleus and electron-nucleus scattering; nonrelativistic theory of nucleon-nucleus reactions; relativistic many-body theory at finite temperature and density; and neutrino interactions in dense matter. This paper discusses this work.

15715 (ECN-RX–90-039) **Alternative statistics in multi-step direct reaction theory.** Koning, A.J. Netherlands Energy Research Foundation, Petten (Netherlands). Jun 1990. 31p. (CONF-9006213–: International Atomic Energy Agency (IAEA)-CRP on fast neutron cross-sections conference, Vienna (Austria), 20-22 Jun 1990). Order Number DE91625451. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted for publication.

In recent years a variety of statistical theories have been developed concerning multistep direct (MSD) nuclear reactions. In addition, dominant in applications is a whole class of semiclassical models that may be subsumed under the heading of 'generalized exciton model': these are basically MSD-type extensions on top of compound-like concepts. In this report the relationship between their underlying statistical MSD-postulates are highlighted. A common framework is sketched that enables to generate the various MSD theories through assigning statistical properties to different parts of the nuclear Hamiltonian. Then it is shown that distinct forms of nuclear randomness are embodied in the mentioned theories. All these theories appear to be very similar at a qualitative level. In order to explain the high-energy tails and forward-peaked angular distribution typical for particles emitted in MSD reactions, it is imaged that the incident continuum particle stepwise looses its energy and direction in a sequence of collisions, thereby creating new particle-hole pairs in the target system. At each step emission may take place. The statistical aspect comes in because many continuum states are involved in the process. These are supposed to display chaotic behavior, the associated randomness assumption giving rise to important simplifications in the expressions for the MSD emission cross sections. This picture suggests that the mentioned MSD models can be interpreted as variants of essentially one and the same theory. However, this appears not to be the case. To show this the usual MSD distinction within the composite reacting nucleus between the fast continuum particle and the residual system is introduced. One implication is that the mutual residual interactions of the nucleons of the residual core are to be distinguished from those of the leading particle with the residual system. This distinction will turn out to be central to the present analysis. (author).

15716 (FEI–2059) **Numerical methods of calculation of final product angular correlations in three-particle sequence nuclear reactions.** Titarenko, N.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1989. 19p. (In Russian). Order Number DE91624010. Source: OSTI; NTIS (US Sales Only); INIS.

General formulae for calculating angular correlations between the directions of three-particle sequential nuclear reaction product escape are derived within the framework of a model-independent approach. Specific expressions for spin-tensors of nucleus-state density matrix, excited by direct reaction mechanism are obtained. 10 refs.

15717 (GSI–91-02(prepr.)) **Production of b and anti b quarks by photon-gluon fusion in heavy-ion collisions.** Hofmann, C. (Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.)); Soff, G.; Schaefer, A.; Greiner, W. Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Jan 1991. 14p. Order Number DE91764563. Source: OSTI; NTIS (US Sales Only); INIS.

Electromagnetic Higgs production in heavy-ion collisions at LHC or SSC has been proposed to detect Higgs particles in the mass range $m_Z < m_H < 2m_W$. We consider the fusion of a photon and a gluon into b and anti b quarks as background to the banti b decay of these Higgs particles. We multiplied the cross section for the elementary process $\gamma g \rightarrow$banti b with the photon distribution in the Weizsaecker-Williams approximation and the gluon distribution inside the nucleus. The photon-gluon fusion turns out to be much stronger than the banti b photoproduction background and hides this higgs signal completely. Furthermore we discuss the possibility to utilize the photon-gluon fusion into banti b and canti c in order to determine the gluon distribution of the nucleon inside the nucleus, e.g., at RHIC. (orig.).

15718 (GSI–91-09(prepr.)) **K^+ production in relativistic nuclear collisions.** Russkikh, V.N. (Kurchatov Inst. of Atomic Energy, Moscow (USSR)). Gesellschaft fuer Schwerionenforschung mbH, Darmstadt (Germany, F.R.). Jan 1991. 23p. Order Number DE91764945. Source: OSTI; NTIS (US Sales Only); INIS.

Production of positive kaons in nuclear collisions at energies $\simeq$ 1-10 GeV/nucleon is studied within the 3-dimensional fluid dynamics and hadrochemical kinetics. Two limiting scenarios of kaon evolution are considered: (a) Produced kaons are in a state of thermal- and mechanical equilibrium with the gas of nonstrange hadrons up to a certain freeze-out moment; (b) kaons escape from the system immediately after the production. The model reproduces the total cross sections of Ne+NaF$\rightarrow K^+ +$X, Ne+Pb$\rightarrow K^+ +$X reactions at E_{lab}=2.1 GeV/nucleon and momentum distribution of K^+ in central Si+Au collisions at E_{lab}=13.6 GeV/nucleon. A strong dependence of the K^+-yield on the nuclear equation of state has been shown. (orig.).

15719 (IAE–4854-1) **Nuclear rotation. Part 6: 6.Quasiclassical model for odd nucleons spin alignment.** Kamchatnov, A.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 20p. Order Number DE91625426. Source: OSTI; NTIS (US Sales Only); INIS.

The quasiclassical treatment of the model 'rotator+particle' is suggested. The classical equations of motion for this model are obtained. General solution of these equations is given. The actual for nuclear physics stationary rotations are studied in detail. The applications of model to the phenomenon of alignment of the 'odd nucleons' angular momentum along the vector of angular velocity is discussed. The comparison with the experiment shows a good agreement with the theoretical results. 17 refs.; 4 figs.

15720 (IAEA-NDS–93(Rev.0)) **ALICE-87 (Livermore). Precompound Nuclear Model Code. Version for Personal Computer IBM/AT.** Blann, M. (Lawrence Livermore National Lab., CA (USA)). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. May 1988. 92p. Order Number DE91625452. Source: OSTI; NTIS (US Sales Only); INIS.

Implemented on PC by D.E. Cullen, V. Goulo.

The precompound nuclear model code ALICE-87 from the Lawrence Livermore National Laboratory (USA) was implemented for use on personal computer. It is available on a set of high density diskettes from the Data Bank of Nuclear Energy Agency (Saclay) and the IAEA Nuclear Data Section. (author). Refs and figs.

15721 (IAEA-NDS–94(Rev.0)) **ICAR-code for combinational calculations of level densities.** Reffo, G. (ENEA, Bologna (Italy)); Herman, M.W. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. May 1988. 58p. Order Number DE91625427. Source: OSTI; NTIS (US Sales Only); INIS.

Implemented on PC by V. Goulo.

ICAR-code for combinatorial calculations of level densities from ENEA Bologna, Italy, was implemented for use on personal computer. It is available on diskettes from the NEA Data Bank, Saclay, and the IAEA Nuclear Data Section. (author). Refs and figs.

15722 (IAEA-NDS–95(Rev.0)) **EMPIRE. Pre-equilibrium/Compound Nuclear Model Code for Personal Computer.** Marcinkowski, A. (Institute of Nuclear Studies, Warsaw (Poland)). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. May 1988. 39p. Order Number DE91624011. Source: OSTI; NTIS (US Sales Only); INIS.

Implemented on PC by V. Goulo.

The pre-equilibrium/compound nuclear model code EMPIRE was implemented for use on personal computer. It is available on a set of diskettes from the NEA Data Bank of Nuclear Energy Agency (Saclay, France) and the IAEA Nuclear Data Section. (author). Refs, figs and tabs.

15723 (IAEA-NDS–99(Rev.0)) **STAPRE and SCAT2. Statistical pre-equilibrium and optical nuclear model code for Personal Computer IBM/AT.** Goulo, V.G. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Jan 1988. 42p. Order Number DE91625453. Source: OSTI; NTIS (US Sales Only); INIS.

This document describes the content of the diskettes with nuclear data production codes SCAT2 and STAPRE and the example data set for implementing and testing of these codes for personal computers IBM/AT. They are available on two diskettes, free to charge, upon request from the NEA Data Bank, Saclay, France. (author). 4 refs, 1 fig.

15724 (IAEA-NDS–104(Rev.0)) **The Evaluated Nuclear Structure Data File (ENSDF). Its philosophy, content and uses.** Burrows, T.W. (National Nuclear Data Center, Upton, NY (USA)). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Apr 1989. 11p. Contract DE-AC02-76CH00016. (BNL-NCS–42566.). Order Number DE91623967. Source: OSTI; NTIS (US Sales Only); INIS.

The Evaluated Nuclear Structure Data File (ENSDF) is maintained by the National Nuclear Data Center (NNDC) on behalf of international Nuclear Structure and Decay Data Network sponsored by the International Atomic Energy Agency, Vienna. For $A \geq 44$ the file is used to produce the Nuclear Data Sheets. Data for A=5 to 44 are extracted from the evaluations published in Nuclear Physics. The contents of ENSDF are briefly described as is the philosophy and methodology of ENSDF evaluations. Also discussed are the services available at various nuclear data centers and the on-line services of the NNDC. Application codes developed for use with ENSDF are described with the program RADLST used as an example. The interaction of ENSDF evaluations with other evaluations is also discussed. (author). 23 refs, 3 tabs.

15725 (INDC(CUB)–004/L) **Analysis of experimental data on neutron-induced reactions and development of code PCROSS for the calculation of differential pre-equilibrium emission spectra with modelling of level density function: Final report on research contract 5472/RB.** Capote, R. (Higher Inst. of Nuclear Science and Technology, La Habana (Cuba)); Osorio, V.; Lopez, R.; Herrera, E.; Piris, M. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Mar 1991. 32p. Translated by the IAEA. Order Number DE91625454. Source: OSTI; NTIS (US Sales Only); INIS.

Translated by the IAEA.

A new PC code PCROSS for neutron induced reaction calculations up to 25 MeV incident energy was developed, where the latest theoretical development in the preequilibrium model was employed. For the proper description of the high energy tail of the emission spectra and excitation function calculations a combination of the Exciton model and direct reaction parametrization was used. In the PCROSS code several models for level density calculations are available. The code is user-friendly, as it included a subroutine to generate the input data. In the present paper some calculation

results for (n,n') and (n,p) emission spectra and for (n,p) and (n,2n) excitation functions up to 20 MeV have been shown. A good description of the experimental data was achieved. 86 refs, 7 figs.

15726 (INDC(NDS)–238/L) **Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.** Kocherov, N.P. (ed.) (International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. 194p. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

The meeting proceedings were divided into three sessions devoted to the following topics: Experimental measurement and techniques (3 papers), calculation of photon cross-sections (9 papers), and evaluation (2 papers). A separate abstract was prepared for each of these papers. Refs, figs and tabs.

15727 (INDC(NDS)–238/L, pp. 39-48) **Pre-equilibrium gamma emission in nuclear reactions.** Betak, E. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Fyzikalny Ustav); Oblozinsky, P. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. Contract IAEA-5148/RB. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). In *Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.* 194p. Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

The present status of the single-particle mechanism for the pre-equilibrium gamma emission mechanism is outlined shortly, and its place among other models of the γ emission is shown. The main attention is devoted to the exciton model, but also other ones are treated. (author). 41 refs, 8 figs.

15728 (INDC(NDS)–238/L, pp. 49-62) **γ-emission within a statistical multistep reaction model.** Kalka, H. (Technische Univ., Dresden (Germany, F.R.). Sektion Physik). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). In *Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.* 194p. Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

A unique description of emission spectra as well as excitation functions in nuclear reactions is proposed within a pure statistical multistep approach. This approach is based on random matrix physics and derives from Green's function formalism. In this model the total emission spectrum of the reaction is divided in three main parts: The first one is the statistical multistep direct part, the second one is the statistical multistep compound emission, and the third one is the multiple particle emission. 34 refs, 18 figs, 1 tab.

15729 (INDC(NDS)–238/L, pp. 63-73) **Gamma ray emission from multistep compound reactions.** Oblozinsky, P. (Oxford Univ. (UK). Nuclear Physics Lab.); Chadwick, M.B. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). In *Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.* 194p. Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

The multistep compound formalism of Feshbach, Kerman, and Koonin has been extended to include γ ray emission. By allowing the first few simple preequilibrium bound states to decay via electromagnetic transitions rather than particle emission, the large number of high-energy γ rays observed in the experimental data can be understood. It is assumed that single-particle and hole transitions lead to the emission of γ rays, and radial matrix elements for such transitions are estimated by exploiting the inverse process, photoabsorption. Reactions of 14 MeV neutrons with ^{59}Co, ^{93}Nb, and ^{181}Ta are analyzed and it is found that between twenty and fifty percent of cross sections for high-energy γ ray emission can be accounted for by the multistep compound mechanism. (author). 27 refs, 3 figs.

15730 (INDC(NDS)–238/L, pp. 75-82) **Preequilibrium emission of hard photons in photon-nucleus reactions.** Oblozinsky, P. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Fyzikalny Ustav). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). In *Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.* 194p. Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

The preequilibrium hybrid model is extended to account for emission of hard photons using the quasideuteron radiative concept and detailed balance. We analyse proton-nucleus reactions, find good accord with the observed photon spectra at 72 MeV incident energy and predict two times higher spectra than the observed ones at 140 MeV. (author). 17 refs, 3 figs.

15731 (INDC(NDS)–238/L, pp. 83-89) **Neutron-gamma competition in nucleon-induced reactions.** Betak, E. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Fyzikalny Ustav); Cvelbar, F. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). In *Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.* 194p. Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

The pre-equilibrium model of the γ emission is used to study the competition of γ and nucleon emission. Mainly we investigated the ratio of γ-to-total emission widths $\Gamma\gamma/\Gamma$tot, the exclusive nucleon spectra, the γ multiplicities (also the differential ones), and the relation of the activation to the integrated cross section for the nucleon radiative capture. All the calculations were performed within a unique master-equation approach to the exciton model, which has been formally extended to cover also the equilibrium (i.e. the compound-nucleus) emission. The results are in strong support to the pre-equilibrium model used for the γ emission. (author). 15 refs, 8 figs, 1 tab.

15732 (INDC(NDS)–238/L, pp. 91-101) **Calculation of photon production cross sections and spectra from ^{52}Cr(n,xγ) reactions at 14.6 MeV.** Maino, G. (ENEA, Bologna (Italy)); Mengoni, A.; Oblozinsky, P. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). In *Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.* 194p. Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

Advanced statistical model of nuclear reactions is used to analyze ^{52}Cr(n,xγ) reactions at 14.6 MeV neutron incident energy.

Calculated are discrete γ ray production cross sections, total γ ray spectrum and average γ ray multiplicities. It is found that integral quantities and data that involve sufficient averaging, such as γ multiplicities, can be predicted with good precision. This is valid also for strong discrete γ lines. Generally, however, discrete γ ray production cross sections cannot be safely predicted better than within a factor of two. Things may even be worse for particular portions of the total γ ray spectrum. (author). 16 refs, 1 fig., 9 tabs.

15733 (INDC(NDS)–238/L, pp. 103-112) **Present status of gamma-ray strength functions and their impact on statistical model calculations.** Kopecky, J. (Netherlands Energy Research Foundation, Petten (Netherlands)); Uhl, M. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). In *Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.* 194p. Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

Photon strength functions derived from discrete resonance data in earlier surveys have been reviewed. Corrections for major non-statistical contributions have been applied and derived systematics for f(E1) and f(M1) values can be used for statistical model calculations. (author). 16 refs, 6 figs, 2 tabs.

15734 (INDC(NDS)–238/L, pp. 113-126) **Calculations of capture cross sections and gamma-ray spectra as a tool for testing strength function models.** Uhl, M. (Vienna Univ. (Austria). Inst. fuer Radiumforschung und Kernphysik); Kopecky, J. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). In *Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.* 194p. Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

The impact of the low energy behaviour of the E1 and the M1 gamma-ray strength functions on statistical model calculations of radiative neutron capture was studied for targets with mass numbers between 55 and 197. We found strong support for models of the E1 strength function with a non-zero limit if the transition energy tends to zero. Such a low energy behaviour is predicted in theoretical work by Kadmenskij et al. and by Sirotkin. The employed strength functions are derived from a generalized Lorentzian in case of E1 and a standard Lorentzian in case of M1 and E2 radiation. The parameters of these strength functions are based on independent experimental data. No normalizations were applied to the strength functions. We, therefore, recommend to use these strength functions in reaction model calculations for applied purposes. (author). 61 refs, 8 figs, 3 tabs.

15735 (INDC(NDS)–238/L, pp. 127-141) **Two-step cascade transitions following neutron capture: A new source of information of photon strength functions.** Becvar, F. (Karlova Univ., Prague (Czechoslovakia). Fakulta Matematicko-Fyzikalni); Chrien, R.E.; Kopecky, J. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). In *Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.* 194p. Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

The applicability of the sum-coincidence measurements of two-step cascade γ-ray spectra to determination of photon strength functions at intermediate γ-ray energies (3 divided 4 MeV) is discussed. An experiment based on thermal neutron capture in Nd was undertaken at the BNL High Flux Beam Reactor to test this method. To understand the role of various uncertainties in similar experiments a series of model calculations was performed. We present an analysis of our experimental data which demonstrates the high sensitivity of the method to E1 and M1 photon strength functions. (author). 5 refs, 7 figs.

15736 (INDC(NDS)–238/L, pp. 145-147) **High energy gammas in nuclear collisions: Necessary data.** Nosov, A.A. (Radievyj Inst., Leningrad (USSR)); Rimski-Korsakov, A.A.; Yakovlev, R.M.; Zubkov, M.N. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee; Ceskoslovenska Komise pro Atomovou Energii, Prague (Czechoslovakia). Nov 1990. (CONF-9002109–: Specialists' meeting on measurement, calculation and evaluation of photon production cross sections, Smolenice (Czechoslovakia), 5-7 Feb 1990). In *Measurement, calculation and evaluation of photon production cross-sections: Proceedings of the specialists' meeting held in Smolenice, the Czech and Slovak Federal Republic, 5-7 February 1990.* 194p. Order Number DE91624012. Source: OSTI; NTIS (US Sales Only); INIS.

Yields and spectra of high-energy gammas, produced in nuclear collisions, are important from a purely scientific and practical point of view. We here demonstrate the insufficiency of relevant data in this field by giving two examples: The study of superdense state of nuclear matter in heavy ion collisions at energies of about 100 MeV/nucleon by means of preequilibrium gammas, and the high energy component of gamma-radiation, produced by proton-nucleus reactions at energies above 150 MeV. 10 refs.

15737 (INIS-SU–236/A, pp. 76-89) **Application of programme system BRAND for analysis of activation experiments.** Androsenko, A.A.; Androsenko, P.A.; Davletshin, A.N.; Tolstikov, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 154p. (In Russian). In *Nuclear constants: Scientific-technical collection.* Order Number DE91003078. Source: OSTI; NTIS (US Sales Only); INIS.

Questions related to application of the BRAND program complex, simulating the processes of neutron radiation transfer by Monte Carlo method for analysing the results of measuring the cross sections by activation method, are considered. Results of calculating the corrections to neutron scattering in the air, in the activated sample, which are compared to results by other authors, are presented. The problem of choosing sufficient statistical accuracy of calculation results obtained is considered, choice criterion is proposed and grounded on the base of analysing the calculation results obtained. Questions related to possibilities of applying the complex when planning the forthcoming experiments, analysing experimental results, are discussed and the desired directions in extending the BRAND program complex capabilities are indicated as well. 8 refs.; 4 figs.; 1 tab.

15738 (INIS-SU–236/A, pp. 90-100) **Neutron cross sections and tin isotope strength functions in method of coupled channels.** Pronyaev, V.G.; Kononov, V.N.; Timokhov, V.M.; Trykov, E.L. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 154p. (In Russian). In *Nuclear constants: Scientific-technical collection.* Order Number DE91003078. Source: OSTI; NTIS (US Sales Only); INIS.

Coupled channel method was used for analysis of the low-energy neutron strength functions and cross sections for ^{116,118,120}Sn isotopes. The account of neutron inelastic scattering channels with excitation of low-lying collective states into the coupled channel method gives the possibility of description of the experimental data without introducing of the strong energy dependence of the parameters. 14 refs.; 3 figs.; 1 tab.

15739 (INIS-SU–236/A, pp. 28-50) **Consistent description of level density and nuclear fission probability.** Ignatyuk, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj

Nauke i Tekhnike, Moscow (USSR). 1989. 154p. (In Russian). In *Nuclear constants: Scientific-technical collection.* Order Number DE91003078. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to conference '50 years of nucleus fission investigations', West Berlin, 2-7 Apr 1989.

Consideration is given to the main representations of the current theoretical description of excited nuclei level density. An essential role of consistent consideration of shell and collective effect is demonstrated in the analysis and systematics of experimental data: neutron resonance density, evaporative spectrum of particles, energy dependence of nuclear fissilities by neutrons, light and heavy charged particles. 34 refs.; 7 figs.; 1 tab.

15740 (INIS-SU–236/A, pp. 15-27) **Effect of ^{238}U neutron strength function uncertainties on resonance structure calculation in unresolved resonance region.** Koshcheev, V.N.; Manturov, G.N.; Sinitsa, V.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 154p. (In Russian). In *Nuclear constants: Scientific-technical collection.* Order Number DE91003078. Source: OSTI; NTIS (US Sales Only); INIS.

Effect of uncertainty of knowing the mean ^{238}U resonance parameters on the calculation of the factor of self-shielding of a total cross section and the radiation capture cross section and the corresponding Doppler increments is investigated. It is shown that an uncertainty, present in the neutron strength function $S_n^0 \approx (0.9\text{-}1.2)\times10^{-4}$ produces a weak effect on the radiation capture cross section self-shielding description. The effect of the total cross section self-shielding depends on S_n^0 value, but the requirements to the accuracy of its description are met under the uncertainty present in the neutron strength function. 26 refs.; 5 figs.; 1 tab.

15741 (INIS-SU–237/A) **Nuclear constants: Scientific-technical collection.** Voprosy atomnoj nauki i tekhniki. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989 154p. (In Russian). Order Number DE91003078. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers in this collection and indexed.

15742 (INIS-SU–238/A, pp. 36-41) **On cross section of charged particle reactions with nuclei in optical model with strong absorption.** Belyak, V.I. (AN SSSR, Moscow (USSR). Inst. Yadernykh Issledovanij). AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989. 56p. (In Russian). In *Plasma physics: Collection.* Order Number DE91003082. Source: OSTI; NTIS (US Sales Only); INIS.

On expression for cross sections of charged particle (hadrons, heavy ions) reaction with nuclei in an optical model with strong absorption is derived using the eikonal decomposition method and its generalization in which the Coulomb interaction is accounted quasiclassically. This expression can be interpreted as a generalization of charged particle absorption cross section on a black nucleus. 3 refs.

15743 (INIS-SU–238/A, pp. 35-37) **On the peculiarity of hadron generation in antineutron interaction with nuclei.** Andreev, V.F.; Baranov, P.S.; Baranov, S.P.; Levonyan, S.V.; Pol', Yu.S.; Fil'kov, L.V. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989. 56p. (In Russian). In *Plasma physics: Collection.* Order Number DE91003082. Source: OSTI; NTIS (US Sales Only); INIS.

An anomalous correlation dependence of proton yield on the number of π-mesons occuring during 6.1 GeV/c pulse antineutrino interaction with tantalum nuclei is analyzed on the base of a thermodynamic approach to hadron matter description. 5 refs.; 1 fig.; 1 tab.

15744 (INIS-SU–239, pp. 35-37) **On decay of doorway states produced in (γ,n) reaction on ^{58}Ni and ^{56}Fe nuclei.** Lapik, A.M. (AN SSSR, Moscow (USSR). Astronomicheskij Sovet); Ratner, B.S. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989. 44p. (In Russian). In *Quantum radiophysics: Collection.* Order Number DE91003091. Source: OSTI; NTIS (US Sales Only); INIS.

Comparison of the data on total cross section oo (γ,n) reaction on ^{58}Ni and ^{56}Fe nuclei with the cross section of emission of energetic photoneutrons from these nuclei confirms nonstatic nature of high-energy component of neutron spectra. 8 refs.; 1 fig.; 3 tabs.

15745 (IPNO-DRE–8946) **Deep inelastic transfers: a way to dissipate energy and angular momentum for reactions in the Fermi energy domain.** Tassan-Got, L.; Stephan, C. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1989. 23p. Order Number DE91767820. Source: OSTI; NTIS (US Sales Only).

A model of stochastic transfers, using a Monte Carlo method and accounting for sequential evaporation, has been elaborated and applied to reactions in the Fermi energy range: between 27 and 44 MeV-A. Its results have been compared to a large set of experimental data: energy spectra, correlations between projectile-like and target-like products, isotopic distributions, neutron multiplicities. Major features of these reactions are reproduced. Beyond this agreement, a modification of the transfer mechanism is needed to incorporate preequilibrium emission.

15746 (IPNO-DRE–9006) **Heavy-ion peripheral collisions in the Fermi energy domain: fragmentation processes or dissipative collisions.** Borderie, B.; Rivet, M.F.; Tassan-Got, L. Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1990. 98p. Order Number DE91767821. Source: OSTI; NTIS (US Sales Only).

For several years a new field in nuclear physics has been opened by the opportunity to accelerate heavy ions through an energy domain including the Fermi energy of nucleons. This new domain has to be seen as a link between dissipative processes observed at low energies, dominated by mean field considerations, and high energy collisions for which nucleon-nucleon collisions play an important role. This paper reviews our present knowledge on peripheral collisions. A reminder of contiguous energy domains is done as well as their extension in the new field. Specific calculations are also presented. Finally a wide comparison between experiments and calculations is performed. A fast dissipative stage proves to be responsible for the dominant mechanisms involved, at least when the incident energy is lower than 50 MeV/nucleon.

15747 (IPNO-DRE–9008) **Signatures for isoscalar spin transitions excited in (d, d$'$) reactions.** Morlet, M. (Paris-11 Univ., 91 - Orsay (FR). Inst. de Physique Nucleaire); Willis, A.; Van de Wiele, J.; Marty, N.; Guillot, J.; Langevin-Joliot, H.; Bimbot, L.; Rosier, L.; Tomasi-Gustafsson, E.; Edwards, G.W.R.; Fergerson, R.W.; Glashausser, C.; Beatty,.Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire. 1990. 12p. Order Number DE91767804. Source: OSTI; NTIS (US Sales Only).

Three different signatures for isoscalar spin transitions in nuclei have been tested in the ^{12}C(d, d$'$)^{12}C reaction at 400 MeV. These signatures have values of close to zero for the natural parity states, and values ranging from 0.22 to 0.50 for the $\Delta S=1$ $\Delta T=0$, 12.7 MeV state.

15748 (ITEF–138-89) **Fast deuteron production in proton-nuclear interactions.** Safronov, G.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 28p. (In Russian). Order Number DE91624028. Source: OSTI; NTIS (US Sales Only); INIS.

Process of fast deuteron production in proton-nuclear interactions is considered within the framework of fusion model. The model of correlated tube, enabling to describe satisfactorily the experimental data without free parameters, is descussed. 33 refs.; 10 figs.

15749 (ITEP–145-88) **The relativistic correction to the triton binding energy in the framework of relativistic Hamiltonian dynamics.** Kondratyuk, L.A.; Lev, F.M.; Solov'ev, V.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1988. 41p. Order Number DE91623969. Source: OSTI; NTIS (US Sales Only); INIS.

The relativstic. 48 refs.; 2 tabs.

15750 (LBL–29502) **Calculation of cross sections for binary reactions between heavy ion projectiles and heavy actinide targets.** Hoffman, D.C.; Hoffman, M.M. Lawrence Berkeley

Lab., CA (USA). Nov 1990. 42p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010222. Source: OSTI; NTIS; INIS; GPO Dep.

The computer program, described in this report, is identified as PWAVED5. It was developed to calculate cross sections for nucleon transfer reactions in low energy heavy ion bombardments. The objective was to calculate cross sections that agree with experimental results for ions of different charge and mass and to develop a predictive capability. It was undertaken because previous heavy ion calculations, for which programs were readily available, appeared to focus primarily on reactions resulting in compound nucleus formation and were not particularly applicable to calculations of binary reaction cross sections at low interaction energies. There are to principal areas in which this computation differs from several other partial wave calculations of heavy-ion reaction cross sections. First, this program is designed specifically to calculate cross sections for nucleon exchange interactions and to exclude interactions that are expected to result in fusion of the two nuclei. A second major difference in this calculation is the use of a statistical distribution to assign the total interaction cross section to individual final mass states.

15751 (LBL–29889) **^{176}Lu: An unreliable s-process chronometer.** Lesko, K.T.; Norman, E.B.; Larimer, R.M.; Sur, B. Lawrence Berkeley Lab., CA (USA). Nov 1990. 29p. Sponsored by USDOE, Washington, DC (USA); National Science Foundation, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010205. Source: OSTI; NTIS; INIS; GPO Dep.

A level scheme of ^{176}Lu up to ~1400 keV excitation energy is deduced from a gamma-gamma coincidence experiment and previously published particle transfer data. 170 gamma-ray transitions are placed between 85 levels, confirming many of the previously established levels and some of the decay scheme. A level at 835.5 keV ($J^{\pi} = 5^-$, $t_{1/2} < 10$ ns) decays with substantial strength to both the ground state (7^-, 4.08×10^{10} yr) and the 122.9 keV isomer (1^-, 3.7 hr). The presence of this level guarantees the thermal equilibration of ^{176}Lu^{g,m} for temperatures greater than 3×10^8 K and therefore during s-process nucleosynthesis. The resulting extreme temperature sensitivity of its effective half-life rules out the use of ^{176}Lu as an s-process chronometer. The use of ^{176}Lu to determine s-process temperatures is discussed. 30 refs., 11 figs., 3 tabs.

15752 (LIYaF–1477) **Energy distribution of intense gamma lines caused by intranucleon excitations.** Sumbaev, O.I. AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki. 1989. 20p. (In Russian). Order Number DE91623970. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental. 7 refs.; 4 figs.; 2 tabs.

15753 (LIYaF–1539) **Hartree-Fock method, generalized model of nucleus and electron scattering on nuclei.** Domchenkov, O.A. AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki. 1989. 45p. (In Russian). Order Number DE91623971. Source: OSTI; NTIS (US Sales Only); INIS.

The relation between the Hartree-Fock calculations and the electron-nucleus scattering data is a problem of consideration. Hartree-Fock wave functions as an intrinsic function of the Bohr-Mottelson model has been examined. The relations between the intrinsic and external single-particle densities depending on nuclear state symmetry and generalizing the well known relation between the intrinsic and external quadrupole moments are obtained. The centre-of-mass problem is solved as a problem of comparison of a theory with experiment. Calculated form factors for the 1p-shell are given and discussed. 22 refs.; 1 fig.

15754 (LIYaF–1551) **On electron mass hidden in the energies of the intense gamma lines.** Sumbaev, O.I. AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki. 1989. 26p. (In Russian). Order Number DE91623972. Source: OSTI; NTIS (US Sales Only); INIS.

tHE STATISTICALLY. 10 refs.; 2 figs.; 2 tabs.

15755 (LIYaF–1565) **The role of the final state interaction in the ionization of the K- shell during the β-decay of nuclei.** Drukarev, E.G.; Trzhaskovskaya, M.B. AN SSSR, Leningrad (USSR). Inst. Yadernoj Fiziki. 1989. 18p. Order Number DE91624066. Source: OSTI; NTIS (US Sales Only); INIS.

We have calculated the contribution of the final state interaction to the ionization of the K-shell during the β^- and β^+ decays. The contributions to the spectra of the β particles and to the total probability of the K shell ionization are obtained. The disagreement between the calculated values and the experimental data for the latter is shown to diminish strongly. The influence of the secondary electrons on the distribution is also determined. 27 refs.; 2 figs.; 2 tabs.

15756 (ORNL/TM–11812) **Computed secondary-particle energy spectra following nonelastic neutron interactions with ^{12}C for E_n between 15 and 60 MeV: Comparisons of results from two calculational methods.** Dickens, J.K. Oak Ridge National Lab., TN (USA). Apr 1991. 71p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010454. Source: OSTI; NTIS; INIS; GPO Dep.

The organic scintillation detector response code SCINFUL has been used to compute secondary-particle energy spectra, $d\sigma/dE$, following nonelastic neutron interactions with ^{12}C for incident neutron energies between 15 and 60 MeV. The resulting spectra are compared with published similar spectra computed by Brenner and Prael who used an intranuclear cascade code, including alpha clustering, a particle pickup mechanism, and a theoretical approach to sequential decay via intermediate particle-unstable states. The similarities of and the differences between the results of the two approaches are discussed. 16 refs., 44 figs., 2 tabs.

15757 (OUP–91-05) **Folded-diagram effective interactions with the Bonn meson-exchange potential model.** Hjort-Jensen, M. (Oslo Univ. (Norway). Fysisk Inst.); Osnes, E.; Muether, H. Oslo Univ. (Norway). Fysisk Inst. Feb 1991. 50p. Order Number DE91624431. Source: OSTI; NTIS (US Sales Only); INIS.

A modern version of the Bonn One-Boson-Exchange potential has been used in a folded diagram expansion of the effective interation appropriate for sd - shell nuclei. Two different techniques for the summation of the folded diagrams have been studied, including all one-body and two-body valence-linked diagrams through third order, and using both a harmonic-oscillator (HO) basis and a Brueckner-Hartree-Fock (BHF) basis. The folded-diagram expanision of Kuo and co-workers shows a slow convergence when the HO choice is made, whereas the vertex renormalization procedure of Lee and Suzuki results in a rapidly converging expanision for the effective interaction. The convergence is very good for both iteration techniques when the self-consistent BHS basis is used. 31 refs., 12 figs., 7 tabs.

15758 (PCCF-RI–9007) **An experiment to detect quark effects in nuclei.** Bertin, P.Y. (Clermont-Ferrand-2 Univ., 63 - Aubiere (FR). Lab. de Physique Corpusculaire); Guichon, P.A.M. Clermont-Ferrand-2 Univ., 63 - Aubiere (France). Lab. de Physique Corpusculaire. 1990. 10p. Order Number DE91767805. Source: OSTI; NTIS (US Sales Only).

We propose to study inside the nuclei, the leptonic decay (e^+e^-), of light meson vector rho, to detect the effect of coupling of nuclear field with a qantiq. If the effect exists we must observe a downward shift ($\simeq$ 120 MeV) in the invariant mass spectrum of the lepton pair. We give a prediction of the distribution expected in future experiments.

15759 (UCRL–53946) **NUSTART: A PC code for NUclear STructure And Radiative Transition analysis and supplementation.** Larsen, G.L.; Gardner, D.G.; Gardner, M.A. Lawrence Livermore National Lab., CA (USA). Oct 1990. 87p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91010045. Source: OSTI; NTIS; INIS; GPO Dep.

NUSTART is a computer program for the IBM PC/At. It is designed for use with the nuclear reaction cross-section code STAPLUS, which is a STAPRE-based CRAY computer code that is being developed at Lawrence Livermore National Laboratory. The NUSTART code was developed to handle large sets of discrete nuclear levels and the multipole transitions among these levels; it operates in three modes. The Data File Error Analysis mode analyzes an existing STAPLUS input file containing the levels and their

multipole transition branches for a number of physics and/or typographical errors. The Interactive Data File Generation mode allows the user to create input files of discrete levels and their branching fractions in the format required by STAPLUS, even though the user enters the information in the (different) format used by many people in the nuclear structure field. In the Branching Fractions Calculations mode, the discrete nuclear level set is read, and the multipole transitions among the levels are computed under one of two possible assumptions: (1) the levels have no collective character, or (2) the levels are all rotational band heads. Only E1, M1, and E2 transitions are considered, and the respective strength functions may be constants or, in the case of E1 transitions, the strength function may be energy dependent. The first option is used for nuclei closed shells; the bandhead option may be used to vary the E1, M1, and E2 strengths for interband transitions. K-quantum number selection rules may be invoked if desired. 19 refs.

6540 Radiation and Shielding Physics

Refer also to citation(s) 14228, 14574, 15111, 15135, 15946, 16020

15760 (ANL/CP–71146) **Present status and future prospects of neutronics Monte Carlo.** Gelbard, E.M. Argonne National Lab., IL (USA). [1990]. 22p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-900970–6: International conference on Monte Carlo methods in neutron and photon transport, Budapest (Hungary), 25-28 Sep 1990). Order Number DE91010573. Source: OSTI; NTIS; GPO Dep.

Cross sections uncertainties are now almost the only inherent limitations in our Monte Carlo capabilities. For this reason Monte Carlo has come to occupy a special position, interposed between experiment and other computational techniques. More and more often deterministic methods are tested by comparison with Monte Carlo, and cross sections are tested by comparing Monte Carlo with experiment. In this way one can distinguish very clearly between errors due to flaws in our numerical methods, and those due to deficiencies in cross section files. The special role of Monte Carlo as a benchmarking tool, often the only available benchmarking tool, it makes it crucially important that this method should be polished to perfection. Unfortunately it is far from perfect now, as one can see by surveying the problems we still face. Turning to these problems in this paper, we follow the pattern of the earlier review starting again with a discussion of eigenvalue calculations.

15761 (EML–529) **A VAX version of the coupled Monte Carlo transport codes HETC and MORSE-CGA.** Sanna, R.S. USDOE Environmental Measurements Lab., New York, NY (USA). Dec 1990. 105p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009714. Source: OSTI; NTIS; INIS; GPO Dep.

The three-dimensional Monte Carlo transport codes, HETC and MORSE-CGA, are distributed by the Radiation Shielding Information Center at Oak Ridge National Laboratory. These codes, written for IBM-3033 computers, have been installed on the Environmental Measurements Laboratory's VAX/11-750 computer for operation in a coupled mode to study the transport of neutrons over the energy range from thermal to several GeV. This report is a guide to their use on the VAX/11-750 computer. 26 refs., 6 figs., 14 tabs.

15762 (FEI–1984) **Solution of two-dimensional equations of neutron transport in $4P_0$-approximation of spherical harmonics method.** Polivanskij, V.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst. 1989. 12p. (In Russian). Order Number DE91623951. Source: OSTI; NTIS (US Sales Only); INIS.

The method to solve two-dimensional equations of neutron transport using $4P_0$-approximation is presented. Previously such approach was efficiently used for the solution of one-dimensional problems. New an attempt is made to apply the approach to solution of two-dimensional problems. Algorithm of the solution is given, as well as results of test neutron-physical calculations. A considerable as compared with diffusion approximation is shown. 11 refs.

15763 (FEI–1985) **On one approximation of transport equation in scatteringless medium.** Usanov, V.I. Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1989. 29p. (In Russian). Order Number DE91623958. Source: OSTI; NTIS (US Sales Only); INIS.

System of two equations with two unknowns one of which is reduced to diffusion equation with diffusion factor representing continuous function of coordinates is obtained on the basis of resolution of radiation phase density in scatteringless matter using basis functions introduced in the paper and determination of corresponding boundary conditions. Using plane geometry with isotropic and monodirected source as an example it is shown that this system is solvable one and basically with selection of respective weight multipliers in boundary conditions it allows to obtain presise solutions of these problems. Some non-traditional efforts with vectors are determined and used in terms of the suggested approach. 4 refs.; 4 figs.

15764 (IAE–4968-14) **Horizontal neutron microscope.** Arzumanov, S.S. (and others); Karaseva, I.A.; Kudryashov, Yu.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 16p. (In Russian). Order Number DE91623952. Source: OSTI; NTIS (US Sales Only); INIS.

The principle of action and construction of neutron microscope with ultracold neutrons are described. The main distinction of this set-up is horizontal neutron flight path. Preliminary results of first experiments with this microscope are presented. 15 refs.; 11 figs.

15765 (IAEA-NDS–89(Rev.0)) **XCOM: Photon cross-sections on a PC. Version 1.2 of 9 May 1987.** Berger, M.J. (National Inst. of Standards and Technology, Gaithersburg, MD (USA)); Hubbell, J.H.; Lemmel, H.D. (ed.). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Nov 1987. 1p. Order Number DE91623959. Source: OSTI; NTIS (US Sales Only); INIS.

A computer program and data base are presented which can be used to calculate, with a personal computer, photon cross-sections for scattering, photoelectric absorption and pair production, as well as total attenuation coefficients, in any element, compound or mixture, at energies from 1 keV to 100 GeV. A set of two diskettes is available upon request, costfree, from the IAEA Nuclear Data Section. (author).

15766 (IAEA-NDS–97(Rev.1)) **ENDF/B-6 Thermal Neutron Scattering Law Library.** Goulo, V.; Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1990. 218p. Order Number DE91625421. Source: OSTI; NTIS (US Sales Only); INIS.

This library contains scattering law data S (α,β) for 9 materials used for thermal reactor and shielding calculations: H_20, D_20, Be, Be0, C, CH_2, C_6H_6, $U0_2$. ZrH_x for temperatures from 296 to 1000 or 1200 deg. K. Data are in ENDF-3 or in ENDF-6 format. The library is available from the IAEA Nuclear Data Section on magnetic tape, costfree upon request. (author). Refs, figs and tabs.

15767 (IAEA-NDS–121(Rev.0)) **JEF-1 Thermal Neutron Scattering Law Data: Brief summary of contents.** Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1990. 1p. Order Number DE91623953. Source: OSTI; NTIS (US Sales Only); INIS.

This document gives a brief documentation of the JEF-1 Thermal Neutron Scattering Law data Library available free of charge on magnetic tape from the IAEA Nuclear Data Section. (author).

15768 (IFVE-ORI–89-145) **Characteristics of muon accompaniment in matter.** Lanev, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 20p. (In Russian). Order Number DE91623960. Source: OSTI; NTIS (US Sales Only); INIS.

Characterictics of electromagnetic showers associated with muon in the matter are calculated. The accopaniment probability has been shown to rise significantly with muon energy if it exceeds a few hundreds GeV. The effect of various material has been explored.

15769 (INDC(CCP)–322/L, pp. 5-12) **Measurement and analysis of neutron transmission and self-indication of the neutron radiative capture cross-section for ^{238}U in the 5-110 keV energy region.** Bokhovko, M.V.; Kononov, V.N.; Manturov, G.N.; Poletaev, E.D.; Sinitsa, V.V.; Voevodskij, A.A. International Atomic

Energy Agency, Vienna (Austria). International Nuclear Data Committee. Dec 1990. Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-310/G. In *Translation of selected papers published in Yadernye Konstanty (Nuclear Constants 3, 1988)*. 19p. Order Number DE91623087. Source: OSTI; NTIS (US Sales Only); INIS.

Translated by the IAEA. Original report in Russian was distributed as INDC(CCP)-310/G.

The results of the measurement and analysis of neutron transmission using the total cross-section and of self-indication of the neutron capture cross-sections for ^{238}U in the 5-110 keV neutron energy region are presented. 16 refs, 3 figs, 4 tabs.

15770 (INIS-mf–12797) **Fluence and spectrometry of 14 Mev neutrons. Application to the excitation function of 56-Fe(n,p) 56-Mn reaction.** Chiadli, A. Universite Mohammed 5, Rabat (Morocco). Faculte des Sciences. 3 Jul 1982 101p. (In French). Order Number DE91625422. Source: OSTI; NTIS (US Sales Only); INIS.

The fluence and the spectrometry of 14 Mev neutrons produced by the 400 Kv S.A.M.E.S. neutron generator of Nuclear Physics Laboratory of Rabat (L.P.N.R.) have been studied to determine the parameters influencing the neutron energy and consequently the cross sections measurement, i.e. the nuclear beam D_2^+/D^+ ratio, the tritium profile and the atomic Tritium/Titane ratio in the Ti-T target. These parameters are determined using a fitting with experimental curve D = f(THT) (neutrons outcoming versus very high voltage). The presence of D^+ and D_2^+ in the deutons beam leads to two neutron groups. The energy calculation has shown a very high discrepancy between these two groups of neutrons around $\theta = 0^0$, whereas it is negligible around $\theta = 98^0$. An excellent agreement is obtained between the neutrons average energy calculated taking into account the parameters cited above and the value measured using cross sections ratio of 90-Zr (n,2n) 89m+g-Zr and 93-Nb(n,2n)92m-Nb reactions. The neutrons distribution has also been determined in order to show up the neutron flux anisotropy. An application of this study to the excitation function of 56-Fe(n,p) 56-Mn reaction between 13.77 and 14.83 has been carried out. 19 figs., 26 tabs., 42 refs. (author).

15771 (INIS-SU–232, pp. 11-14) **Electromagnetic radiation of monodirected current pulse in transparent dispersionless medium.** Chernukhin, Yu.I.; Simonenko, V.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1988. 43p. (In Russian). In *Theoretical and applied physics: Scientific-technical collection.* Order Number DE91003077. Source: OSTI; NTIS (US Sales Only); INIS.

Solution related to electromagnetic radiation (EMR) of monodirected current pulse in the transparent medium without dispersion under its excitation by ionizing radiation source (e.g. fast electrons and γ-quanta) is obtained and analysed. A series of interesting features of such radiation is indicated, including EMR duration reduction in an ultrarelativistic case polarization, high anisotropy, connection with Vavilov-Cherenkov effect and transition radiation. 5 refs.; 2 figs.

15772 (INIS-SU–234, pp. 37-46) **Account for resonance effects in multigroup neutron calculations.** Goncharov, G.A.; Gorelov, V.P.; Grebennikov, A.N.; Malinovskaya, E.V.; Petrov, Yu.V.; Farafontov, G.G.; Yudintsev, V.F. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 82p. (In Russian). In *Simulation of physical processes: Scientific-technical collection.* Order Number DE91003090. Source: OSTI; NTIS (US Sales Only); INIS.

Two methods of resonance effects account in multigroup neutron calculations: the method of factors of resonance self-shielding of cross sections and the subgroup method, are considered. Ways of estimations of resonance specific features of a weight function used when obtaining factors of resonance self-shielding of cross sections are discussed. Specific features of more effective way of resonance effects account related to application of the subgroup method are considered. 8 refs.; 1 fig.

15773 (INIS-SU–235, pp. 16-23) **Isotropization of constants of neutron elastic scattering.** Goncharov, G.A.; Gorelov, V.P.; Farafontov, G.G.; Khoruzhij, V.Kh. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 119p. (In Russian). In *Simulation of physical processes: Scientific-technical collection.* Order Number DE91003084. Source: OSTI; NTIS (US Sales Only); INIS.

The comparison results of possible ways of isotropization of scattering group constants are presented. Special attention is paid to investigation of sequences of occurrence of negative transport constants. The simplest way of negatives limitation is suggested. The results of calculations permitting to separate the most preferable way of isotropization to use it when solving problems on fast neutron transport are presented. 12 refs.; 1 fig.

15774 (INIS-SU–235, pp. 42-48) **On solution of P_{2N-1} - approximation of neutron transport equation in sphere with central point isotropic source.** Gorelov, V.P.; Travin, V.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 119p. (In Russian). In *Simulation of physical processes: Scientific-technical collection.* Order Number DE91003084. Source: OSTI; NTIS (US Sales Only); INIS.

Full solution of the P_{2N-1}-approximation of a neutron transport equation in the central point of the sphere containing a point isotropic source at the beginning of coordinates is obtained. Unknown coefficients entering this solution are suggested to determine by the Adamskaya-Godunov method. 6 refs.

15775 (IYaF–89-129) **Anisotropy of cross sections of X-ray Raman scattering in carbon.** Chernov, V.A.; Mytnichenko, S.V.; Sheromov, M.A. AN SSSR, Novosibirsk (USSR). Inst. Yadernoj Fiziki. 1989. 9p. (In Russian). Order Number DE91623962. Source: OSTI; NTIS (US Sales Only); INIS.

Anisotropy of differential cross section of X-ray Raman scattering was detected in high-ordered pyrographite (HOPG). The most intensive value of this effect is observed near Raman scattering excitation threshold. Variations of the shape and energy position of Raman band edge are explained by dependence of π^* and σ^* contribution of vacant electron states into scattering differential cross section on direction of pulse transferred to 1s-electron. Thus, spectroscopy of inelastic X-ray Raman scattering gives, like absorption polarization spectroscopy, information on space distribution of electron vacant states. 7 refs.; 3 figs.

15776 (JAERI-M–90-203) **Evaluation of the computer code system RADHEAT-V4 by analysing benchmark problems on radiation shielding.** Sakamoto, Yukio (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment); Naito, Yoshitaka (eds.). Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 310p. (In Japanese). Order Number DE91767973. Source: OSTI; NTIS (US Sales Only); INIS.

A computer code system RADHEAT-V4 has been developed for safety evaluation on radiation shielding of nuclear fuel facilities. To evaluate the performance of the code system, 18 benchmark problem were selected and analysed. Evaluated radiations are neutron and gamma-ray. Benchmark problems consist of penetration, streaming and skyshine. The computed results show more accurate than those by the Sn codes ANISN and DOT3.5 or the Monte Carlo code MORSE. Big core memory and many times I/O are, however, required for RADHEAT-V4. (author).

15777 (JAERI-M–90-213) **Neutron transmission measurements on gallium in the resonance region.** Ohkubo, Makio (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1990. 20p. Order Number DE91767864. Source: OSTI; NTIS (US Sales Only); INIS.

Neutron transmission measurements were made on natural gallium using a TOF spectrometer of the Japan Atomic Energy Research Institute linear accelerator. Neutron resonance parameters are obtained for 54 levels in the energy region extended up to 10.4 keV. The average level spacing D and the s-wave strength function

S_0 are deduced to be: D = 185 +- 12 eV, S_0 = (1.2 +- 0.2) x 10^{-4} below 10.4 keV. (author).

15778 (KAPL–4721) **Benchmark measurements and calculations of a three-dimensional neutron streaming experiment.** Barnett, D.A. Jr. Knolls Atomic Power Lab., Schenectady, NY (USA). Feb 1991. 37p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC12-76SN00052. (CONF-910414–33: International topical meeting on advances in mathematics, computation and reactor physics, Pittsburgh, PA (USA), 28 Apr - 2 may 1991). Order Number DE91010692. Source: OSTI; NTIS; INIS; GPO Dep.

An experimental assembly known as the Dog-Legged Void assembly was constructed to measure the effect of neutron streaming in iron and void regions. The primary purpose of the measurements was to provide benchmark data against which various neutron transport calculation tools could be compared. The measurements included neutron flux spectra at four places and integral measurements at two places in the iron streaming path as well as integral measurements along several axial traverses. These data have been used in the verification of Oak Ridge National Laboratory's three-dimensional discrete ordinates code, TORT. For a base case calculation using one-half inch mesh spacing, finite difference spatial differencing, an S_{16} quadrature and P_1 cross sections in the MUFT multigroup structure, the calculated solution agreed to within 18% with the spectral measurements and to within 24% of the integral measurements. Variations on the base case using a fewgroup energy structure and P_1 and P_3 cross sections showed similar agreement. Calculations using a linear nodal spatial differencing scheme and fewgroup cross sections also showed similar agreement. For the same mesh size, the nodal method was seen to require 2.2 times as much CPU time as the finite difference method. A nodal calculation using a typical mesh spacing of 2 inches, which had approximately 32 times fewer mesh cells than the base case, agreed with the measurements to within 34% and yet required on 8% of the CPU time. 5 refs., 9 figs., 9 tabs.

15779 (KAPL–4724) **Three-dimensional nodal transport using the simplified P-L method.** Gamino, R.G. Knolls Atomic Power Lab., Schenectady, NY (USA). Dec 1990. 23p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC12-76SN00052. (CONF-910414–32: International topical meeting on advances in mathematics, computation and reactor physics, Pittsburgh, PA (USA), 28 Apr - 2 may 1991). Order Number DE91010214. Source: OSTI; NTIS; INIS; GPO Dep.

A nodal Simplified P-L (SPL) transport method has been extended to three-dimensional X-Y-Z geometry. The SPL equations, which represent an approximate form of the spherical harmonics equations, have been coupled with a fifth order Nodal Expansion Method (NEM). Numerical results from several eigenvalue problems show that the SPL method eliminates >80% of the diffusion theory error is these problems. The method also produces reasonably accurate solutions in two medium-penetration neutron attenuation problems. In addition, for a given mesh spacing, no significant increase in spatial truncation error has been observed as the order of expansion is increased. Computational effort is a factor of two (SP3) to four (SP7) times diffusion theory. This work indicates that the SPL method has very good potential for improved analysis of reactor core and attenuation problems. 20 refs., 10 figs., 8 tabs.

15780 (LA-UR–90-3000) **Los Alamos Science, Number 19, 1990: Neutron scattering.** Cooper, N.G. (ed.). Los Alamos National Lab., NM (USA). 1990. 214p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91009371. Source: OSTI; NTIS; INIS; GPO Dep.

This article explores the physics of various neutron-scattering processes, introduces the experimental techniques and instruments that make neutron scattering so versatile, and discusses the single equation that unifies the interpretation of neutron scattering data. The history of the field, its successes around the world, its present problems in the United States, and the plans for opening it to a wide spectrum of users from academia and industry. This articles traces neutrons from their "birth" in the spallation target through beam-tailoring devices and scattering samples to their "death" in neutron detectors. Samll-angle neutron-scattering experiments provide evidence that calmodulin, a protein that mediates calcium regulation of biological processes, is flexible in solution. Neutron scattering can detect subtle structures beneath the disorder that give advanced materials their extraordinary combinations of strength, elasticity, and low density. Recent neutron-scattering experiments on model systems are revealing how metal atoms loosen the bonds of hydrogen molecules, and essential first step in hydrogenation reactions. Combining data from neutron and x-ray diffraction is the only way to resolve ambiguities in the crystal structure of various materials, including high-temperature superconductors. Although the Bose condensate cannot be observed directly, an interpretation of neutron-scattering data according to a new first-principles theory of final-state effects has at last confirmed its existence in superfluid helium. The maximum entropy method has been applied successfully to neutron-scattering data and could even influence the design of neutron-scattering instruments.

15781 (LA-UR–91-863) **Coupled proton/neutron transport calculations using the S_N and Monte Carlo methods.** Filippone, W.L. (Arizona Univ., Tucson, AZ (USA). Dept. of Nuclear and Energy Engineering); Little, R.C.; Morel, J.E.; MacFarlane, R.E.; Young, P.G. Los Alamos National Lab., NM (USA). [1991]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910414–26: International topical meeting on advances in mathematics, computation and reactor physics, Pittsburgh, PA (USA), 28 Apr - 2 may 1991). Order Number DE91009949. Source: OSTI; NTIS; GPO Dep.

Coupled charged/neutral article transport calculations are most often carried out using the Monte Carol technique. For example, the ITS, EGS, and MCNP (Version 4) codes are used extensively for electron/photon transport calculations while HETC models the transport of protons, neutrons and heavy ions. In recent years there has been considerable progress in deterministic models of electron transport, and many of these models are applicable to protons. However, even with these new models (and the well established models for neutron transport) deterministic coupled neutron/proton transport calculations have not been feasible for most problems of interest, due to a lack of coupled multigroup neutron/proton cross section sets. Such cross sections sets are now being developed at Los Alamos. Using these cross sections we have carried out coupled proton/neutron transport calculations using both the S_N and Monte Carlo methods. The S_N calculations used a code called SMARTEPANTS (simulating many accumulative Rutherford trajectories, electron, proton and neutral transport slover) while the Monte Carlo calculations are done with the multigroup option of the MCNP code. Both SMARTEPANTS and MCNP require standard multigroup cross section libraries. HETC on the other hand, avoids the need for precalculated nuclear cross sections by modeling individual nucleon collisions as the transporting neutrons and protons interact with nuclei. 21 refs., 1 fig.

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Refer also to citation(s) 14206, 14500, 14540, 14543, 15193, 15426

15782 (IAEA-NDS–112(Rev.0)) **Decay data for detector efficiency calibration. Documentation of the GAMDEC DBaseIII data base.** Lorenz, A. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Jan 1989. 27p. Order Number DE91624790. Source: OSTI; NTIS (US Sales Only); INIS.

This report describes the DBaseIII-Plus data files and programs which make up the GAMDEC data base, and the reports produced from this data base. (author). Refs.

15783 (INIS-SU–210, pp. 669-670) **Radiobiological base of radiation injury diagnosis.** Komar, V.E. (Tsentral'nyj Nauchno-Issledovatel'skij Rentgeno-Radiologicheskij Inst., Leningrad (USSR)); Teslenko, V.M. AN SSSR, Moscow (USSR). 1989. 808p. (In Russian). (CONF-8908259–: 1. All-Union radiobiological conference, Moscow (USSR), 21-27 Aug 1989). In *1. All-union radiobiological conference. V. 3: Summaries of reports.* Order Number DE91003025. Source: OSTI; NTIS (US Sales Only); INIS.

Short note. BIOLOGICAL INDICATORS/radiation injuries; RADIATION INJURIES/diagnosis; CHEMICAL RADIATION EFFECTS; IONIZING RADIATIONS; RADIATION DOSES; DIAGNOSIS; STRAND BREAKS

15784 (INIS-SU–231, pp. 20-24) **On the introduction of international unit system in the field of ionizing radiations.** Isaev, B.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Introduction of international SI unit system in the field of ionizing radiations in the USSR is considered. Attention is paid to regulations formulated by Commision on ionizing radiation measurements of Methodologic Councile of the USSR State Comittee for Standards, Directions Introduction and application of 8.417-81 Standards, Units of physical quantities, concerning ionizing radiations recommended all ministries and organizations to comlete changes to SI unit system by January 1, 1990. Along with SI units use of series of off-system units for unlimited term is admitted. For some particles energy electron-volt units are allowed, but joules should not be used. Absorbed dose and dose rate SI units - Gy and Gy/s in radiotherapy and radiation protection are more preparable than μGy/min. Kerma units in Si unit system is Gy gray (Gy). Equivalent dose units are μZv. mZv. Becquerel (Bg) is a SI unit of radionuclide activity in source.

15785 (INIS-SU–231, pp. 60-62) **Account and standardization of collective doses at NPP with WWER.** Romanov, V.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

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A problem of account and standardization of collective doses at NPP with the WWER-1000 reactor in the course of different procedures (scheduled-preventive maintenance-SPM, reactor fueling) is considered. Actuality of placing in on-line condition with acquisition, processing, compilation and transmission to the users of radiation monitoring data is stressed. This problem may be solved using special computers or on the bais of high-power computers by designing a subsystem for acquisition, and processing of data on collective doses and radiation cituation, or joining it with reliability data acquisition and processing system.

15786 (INIS-SU–231, pp. 82-84) **Use of radiation safety principles in technique of release standardization of radioactive materials disposed to river systems.** Pisarev, V.V.; Ctrunehnze, R.L. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

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Methods of calculating maximum permissible disposals (MPD) of radioactive materials to river systems are described. Requirements of Radiation safety standards RSS-76, specifying the levels of ionizing radiation effect on human body, form the basis of these methods. MPD values are determined from the ratio of dose relationship with parameters, defining strength of the source of internal and external irradiation effects.

15787 (INIS-SU–231, pp. 8-13) **Main trends in activities of national committee on radiation protection.** Il'in, L.A.; Buldakov, L.A.; Moskalev, U.I.; Avetisov, G.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Activities of National Comittee on Radiation Protection (NCRP) in related to the problems of intensive development of nuclear power and radiation application to national economy are considered. It is marked that the most important scientific aspects of NCRP activities are stimulation, accumulation, systematization, discussion and concideration of research works and materials on different problems of standardization of ionizing radiations and radiation safety regulations. The NCRP activities for the period of 1982-86 included main trends.

15788 (INIS-SU–231, pp. 3-8) **Actual problems of radiation safety.** Vorob'ev, E.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

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Due to expansion and development of peaceful use of nuclear power actual problems of radiation safety, that at present has become an independent discipline with its own methods and investigation means, are considered. It is marked that development of safety methods and means, increase of personnel qualification and knowledge are the most actual safety problems.

15789 (INIS-SU–231, pp. 31-33) **Radiation-hygienic assessment of heat supply from Beloyarsk NPP.** Koltic, I.I. (and others); Gnedkov, L.E.; Gushchin, Yu.L. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Radiation-hygienic assessment of heat supply from Beloyarsk Npp AMB-100, AMB-200 and BN-600 reactors is carried out. Assessment was based on results of determination of β-activity and radionuclide composition of heating media, hot water supply in comparison with their indices in domestic and drinking water. It is shown that reactor radionuclides do not penetrate into heat supply system of Beloyarsk NPP settlement. Radionuclide deposition in district heating devices is investigated by γ-spectrometry method. Results of studying γ-radiation from heaters of residential and public buildings showed that exposure dose is less than the natural background indoors.

15790 (INIS-SU–231, pp. 33-36) **Forecasting radioisotope effluent into atmosphere according to the signals of detectors of the standard system for fuel can tightness control at the RBMK-1000 reactor.** Zhemchugov, V.P. (and others); Komarov, V.I.; Tkachenko, V.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

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Algorithm for fuel assemblies (FA) with failed elements, based on spectral analysis of steam-water line gamma radiation monitored by the standard system for fuel can tightness control at the RBMK-1000 reactor is suggested. Spectra are considered to correspond

to FA swith unfailed fuel elements and on their basis standard spectrum and vector are elements. FAs with failed fuel elements are detected by spectrum deviations from the standard one.

15791 (INIS-SU–231, pp. 62-65) **Optimization of norms for equipment maintenance by operating NPP personnel on the basis of radiation safety criteria.** Vel'chinskij, V.I. (and others); Kopaev, V.V.; Kolyshkin, A.E. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

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Standardization of NPP personnel labour from the views point of radiation protection is considered. The choice of optimmum equipment maintenance is based on determination of optimum personnel number and minimizing personnel and collective doses. Optimization of NPP operating personnel number is possible on the basis of maintenance standards. Formulation of the above-mentioned standards is based on classification of time requirements for equipment maintenance by operating NPP personnel per shift. Optimization of norms for eqiopment maintenance by operating NPP personnel must be based on a complex of technical-and-economic and hygienic criteria.

15792 (INIS-SU–231, pp. 65-68) **Benefit of actions concerning minimization of collective doses to NPP maintenance personnel.** Volkova, A.V. (and others); Gavgilov, S.D.; Gusakov, A.D. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

On the basis of radiatin safety criteria a problem of optimization of collective doses to NPP maintenance personnel aimed at efficient regulation labour process is considered. Similar complex substantiation will permit an efficient solution of the main methodologic problem of labour normalization - time projection of labour process. It is shown that choice of optimal NPP maintenance scheme is based on determination of optimal personnel number and minimization of individual and collective doses.

15793 (INIS-SU–231, pp. 71-73) **Radiation doses to personnel and human population due to railroad transporation of radioactive materials.** Frejman, Eh.S. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

6 refs. KRB-IV. Chast' 1.

To estimate radiation safety system efficiency contribution of radioactive material railroad transformation to human population irradiation doses in transport personnel, some representatives of human population and passanges were measured. For some groups of peaple personnel dosimetry was used, for most groups radiation dosed were determined by motion-time study and by measuring ionizing radiation dose rates at peoples working positions. Collective dose equivalents for railroaders, passangers and human population from vans, trains transporting radioactive materials are comparatively low. The same may be said about transportation of spent fuel. A conclusion on safety of radioactive material transformation is drawn. 6 refs.

15794 (INIS-SU–231, pp. 96-99) **Snowmetric survey is a component geosystem monitoring at radioactive waste treatment station.** Golubeva, E.I.; Markelov, A.V.; Mineeva, I.Ya.; Ostroglyadov, S.V.; Yarkov, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

3 refs.; 1 tab. KRB-IV. Chast' 1.

To modify snowmetric survey method for geosystem monitoring at radioactive waste treatment station a reconnaissant stage of snowmetric curvey in the forests of radioactive waste treatment station, where one of process cycles allows a constant and limited stack disposal of radionuclides and other chemical elements, is carried out. It is shown that snowmetric survey permits to determine the degree of effluents effects, to denote effluents scattering halo and along with geomorphological and landscape analysis of the territory is a cause for location of optimal monitoring system, blocking all exits of sanitary-protective ares. 3 refs.; 1 tab.

15795 (INIS-SU–231, pp. 152-153) **Foundation of permissible levels for tritium and monitoring its body content.** Buldakov, L.A.; Levochkin, F.K. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Foundation of permissible levels for tritium and monitoring of its body content for radiation protection of people are carried out. The estimation values of permissible levels for tritium take into account its intake with water aqnd food. Determination of tritium content in the body water is a reliable method of monitoring, the environmental contamination with tritium. 3 refs.; 1 fig.

15796 (INIS-SU–231, pp. 166-171) **Risk of ionizing radiation effect is a biological and social category.** Filyushkin, I.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Standardization of ionizing radiation effect on people from medical-biological and social points of view is considered. Scientific substitution of standardization system must be based exclusively on non-threshold concept. Without this step the society can't have objective risk criteria of harmful technologies and formulate economic grounds for its decrease. 10 refs.

15797 (INIS-SU–231, pp. 124-127) **General analytical solution of basic task of indirect dosimetry.** Korelina, N.F.; Likhtarev, I.A.; Repin, V.S. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

General analytical solution of basic task of indirect dosimetry - seeking the function of I(t) radionuclide intake (in case of its arbitrary dependence on time t) is considered. general kinetic equation

for I(t) as a functional of measured V(t) excretion rate and independently found R(t) retention function is constructed. Its general solution is found and particular cases illustrating this solution are considered.

15798 (INIS-SU–231, pp. 127-129) **Indirect dosimetry of internal irradiation due to radionuclide inhalation.** Repin, V.S.; Korelina, N.F.; Likhtarev, I.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

For the case of indirect dosimetry of internal irradiation due to radionuclide inhalation an attempt is made to ground periodicity of monitoring incorporated radionuclides, characterized by ahort excretion period, on the basis of afternative estimations of internal irradiation doses, and also from the view point of putting bounds to uncertainty of dose estimations. Computations are used. It is ahown that monitoring periodicity may be chosen according to accuracy, satisfying each particular radiation situation. As an example, resultsoof THO ^{32}P, ^{35}S monitoring periodicity estimations for the cases, when criteria are either 3 time dose overestimation, or 3-fold underestimation, are presented.

15799 (INIS-SU–231, pp. 129-135) **Statistical analysis of model of aerosol deposition in lungs and standardization of radionuclide aerogenic intake.** Likhtarev, N.A.; Korelina, N.F.; Repin, V.S.; Kochetkov, O.A.; Lana, L.G. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

To improve dosimetry methods and means statistical analysis of some elements of Morrod model (model of aerosol deposition in human lungs) taking into account estimates of radioaerosol deposition in different sections of extraction of radioactive material from them is carried out. Attention is paid to statiatical distribution of aerosols according to their size and also to distribution of other values having an effect on the levels of particle deposition in different parts of respiratory system. Imitation of deposition levels distribution in nasopharynx, tracheobronchial and pulmonary regions and also of total deposition is carried out. variations of kinetic characteristics in the lung model are considered.

15800 (INIS-SU–231, pp. 141-148) **Estimation of waste water activity using serial radiometers.** Digtyar', V.A.; Isakov, L.M.; Prokazova, L.M.; Terekhov, O.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Radiation monitoring of waste water actiivity including operative, element-by-element and periodic monitoring is considered. Operative estimation of waste water activity is carried out using RZhS-05 and RKB4-1eM serial radiometers. The experience of operation using the given radiometers is discussed. Device permit to cover a wide range of activities of large nuclide spectrum, and to solve the main problems of waste waters radiation monitoring.

15801 (INIS-SU–231, pp. 148-149) **Technique for determining ^{137}Csin water samples.** Antonova, V.A.; Prokof'ev, O.N. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. 172p. (In Russian). (CONF-8412143–: 4. all-union scientific-practical conference on radiation safety, Moscow (USSR), 15 Dec 1984). In *Technical progress in nuclear power engineering. 1(72) Part 1: Isotopes in USSR.* Order Number DE91003076. Source: OSTI; NTIS (US Sales Only); INIS.

KRB-IV. Chast' 1.

Studies on simplifying the technique of ^{137}Cs concentration from water samples on silica gel- ShSM in case of sanitary-radiation monitoring of water at NPPs and other nuclear power installations dealing with an open radioactivity are carried out. The scheme of water samples analysis includes: acidity up to pH=4, mixing with silica gel, silica gel separation, desorption of ^{137}Cs in 1H hydrochloric acid solution, radionuclide deposition on double salt of cesium and antimony and beta-radiometry of preparation in a thin layer. Optimum conditions for ^{137}Cs extraction from water samples on silica gel are ascertained.

15802 (NVR–1.3) **Nuclear safety standards: Quality guarantee main code on the safety of nuclear power plants : Adaptation of IAEA Code safety series 50-C-QA (rev. 1).** Ministry VROM-Ministry SZW Collaboration. Ministerie van Sociale Zaken, The Hague (Netherlands); Ministerie van Volkshuisvesting, Ruimtelijke Ordening en Milieubeheer, The Hague (Netherlands). 1989. 25p. Translation of: Code on the safety of nuclear power plants: quality assurance. (In Dutch). Order Number DE91624638. Source: OSTI; NTIS (US Sales Only); INIS.

Translation of: Code on the safety of nuclear power plants: quality assurance.

This document is the into Dutch translated and treated version of the IAEA 'Code on the Safety of Nuclear Power Plants: Quality Assurance'. It contains the foundations which a quality assurance programme has to meet in view of the experiences and the actual technology in order to guarantee sufficient safety. (author). 5 refs.

15803 (SIS–1990:8) **Whole-body counting 1990.** Strand, P.; Selnaes, T.D. Statens Inst. for Straalehygiene, Oslo (Norway). 1990. 18p. (In Norwegian). Order Number DE91624665. Source: OSTI; NTIS (US Sales Only); INIS.

In order to determine the doses from radiocesium in foods after the Chernobyl accident, four groups were chosen in 1987. Two groups, presumed to have a large consumption of food items with a high radiocesium content, were selected. These were Lapp reindeer breeders from central parts of Norway, and hunters a.o. from the municipality of Oeystre Slidre. Two other groups were randomly selected, one from the municipality of Sel, and one from Oslo. The persons in these two groups were presumed to have an average diet. The fall-out in Sel was fairly large (100 kBq/m^2), whereas in Oslo the fall-out level was low (2 kBq/m^2). The persons in each group were monitored once a year with whole-body counters, and in connection with these countings dietary surveys were preformed. In 1990 the Sel-group and the Lapps in central parts of Norway were followed. Average whole-body activity in each group is compared to earlier years's results, and an average yearly effective dose equivalent is computed. The Sel-group has an average whole-body activity of 2800 Bq for men, and 690 Bq for women. Compared to earlier years, there is a steady but slow decrease in whole-body activities. Yearly dose is calculated to 0.06 mSv for 1990. The Lapps in central parts of Norway have an average whole-body content of 23800 Bq for men and 13600 Bq for women. This results in an average yearly dose of 0.9 mSv for the individuals in the group. Compared to earlier years, the Lapp group show a decrease in whole-body contents since 1988. This decrease is larger among men than women. 5 refs., 8 figs., 6 tabs.

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Refer also to citation(s) 14891, 14899, 14916, 15484, 15619

15804 (FEI–1903) **Vanadium and tantalum frequency spectrum deformation by interstitial impurities.** Danilkin, S.A.; Minaev, V.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Obninsk (USSR). Fiziko-Ehnergeticheskij Inst.

1988. 9p. (In Russian). Order Number DE91623605. Source: OSTI; NTIS (US Sales Only); INIS.

Results of calculating metal atom oscillation spectra in disordered solid solutions vanadium-oxygen, vanadium-nitrogen and tantalum-nitrogen in virtual crystal model are presented in the work. It is shown that under nitrogen and oxygen atom implantation frequency distribution deformation takes place: atom oscillation spectrum features and boundary frequency are shifted to the region of higher frequencies by 0.5-1.0 MeV as compared to source metal spectra. The spectrum frequency mean square increases by 3-9% in the phases indicated. Calculation results qualitatively agree with the experimentally observed changes in vanadium and tantalum frequency spectra caused by implanted atoms. 11 refs.; 3 figs.; 2 tabs.

15805 (IAE–4944-1) **Anisotropy of relativistic lepton coherent scattering at axial channeling.** Telegin, V.I.; Kanloev, A.M.; Kungurov, F.R. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 5p. (In Russian). Order Number DE91623659. Source: OSTI; NTIS (US Sales Only); INIS.

The contribution of the coherent and incoherent scattering of relativistic leptons passed through thin crystals in the channeling mode to their angular distribution is considered. The investigation was carried out by numerical integration of the motion equations for a great number of particles. It is shown that in the crystals with a thickness smaller than the dechanneling length the determining role in formation of distribution over the axit angles is played by the coherent scattering of particles by atomic chains. The effect of the multiple scattering on the angular distribution is negligibly small. 6 refs.; 4 figs.

15806 (IC–90/254) **On the functional integral approach in quantum statistics. 1. Some approximations.** Dai Xianxi. International Centre for Theoretical Physics, Trieste (Italy). Aug 1990. 18p. Order Number DE91625257. Source: OSTI; NTIS (US Sales Only); INIS.

In this paper the susceptibility of a Kondo system in a fairly wide temperature region is calculated in the first harmonic approximation in a functional integral approach. The comparison with that of the renormalization group theory shows that in this region the two results agree quite well. The expansion of the partition function with infinite independent harmonics for the Anderson model is studied. Some symmetry relations are generalized. It is a challenging problem to develop a functional integral approach including diagram analysis, mixed mode effects and some exact relations in the Anderson system proved in the functional integral approach. These topics will be discussed in the next paper. (author). 22 refs, 1 fig.

15807 (IC–90/259) **Structural instabilities in Heisenberg antiferromagnets with spin-lattice interaction.** Lagos, M.; Gottlieb, D. International Centre for Theoretical Physics, Trieste (Italy). Aug 1990. 15p. Order Number DE91625258. Source: OSTI; NTIS (US Sales Only); INIS.

The antiferromagnetic S = 1/2 Heisenberg model in one dimension with anisotropic exchange interaction depending on the lattice configuration is dealt with. The emphasis is done in the derivation fo the thermodynamic properties of the model. In addition to the smooth structural transformation starting at T = 0 reported in a previous communication, we find a new sudden transition at a finite temperature. (author). 4 refs, 3 figs.

15808 (IC–90/260) **A study on the anisotropic interaction between two substitutional magnetic impurities in a realistic metallic host.** Satter, M.A. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 6p. Order Number DE91625259. Source: OSTI; NTIS (US Sales Only); INIS.

The relativistic interaction between two magnetic impurities (Fe) in paramagnetic host (Au and Cu) and magnetic anisotropic effect are studied in this article. 5 refs, 2 tabs.

15809 (IC–90/293) **Electron polarization in a quantum well with uniform electric field.** Ilaiwi, K.F.; Tomak, M. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 16p. Order Number DE91625260. Source: OSTI; NTIS (US Sales Only); INIS.

The polarization of a quantum electron confined in a one dimensional potential well in the presence of a uniform electric field is calculated numerically. It is shown that the negative polarization reported in the literature for weak fields for all excited subband states is an artifact of using infinite-barrier model. Our numerical work gives results in agreement with previous calculations for the infinite-barrier potential but it yields positive polarization for all values of the applied field for finite-barrier case. (author). 5 refs, 10 figs.

15810 (IC–90/294) **Effect of oxygen and carbon impurities on the performance of silicon single crystal solar cells.** Akhter, P. (International Centre for Theoretical Physics, Trieste (Italy)); Zakir, M.N.; Baig, A.; Ziadi, Z.I.; Ahmad, M.; Hussain, S.; Qazi, I.A.; Mufti, A. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 9p. Order Number DE91625261. Source: OSTI; NTIS (US Sales Only); INIS.

BSF solar cells are fabricated using B-doped wafers cut from Czochralski Si(100) single crystals. The effect of unintentional impurities of Oxygen and Carbon atoms on the solar cell performance parameters have been studied. The presence of carbon atoms shows an improvement in all parameters particularly the short circuit current where as oxygen shows an adverse effect. (author). 13 refs, 1 fig.

15811 (IC–90/314) **Bulk stress auto-correlation function in simple liquids-sum rules.** Tankeshwar, K. (International Centre for Theoretical Physics, Trieste (Italy)); Bhandari, R.; Pathak, K.N. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 14p. Order Number DE91625262. Source: OSTI; NTIS (US Sales Only); INIS.

Expressions for the zeroth, second and fourth frequency sum rules of the bulk stress auto correlation function have been derived. The exact expressions involve static correlation function up to four particles. Because of the non availability of any information about static quadruplet correlation function we use a low order decoupling approximation for this. In this work, we have obtained, separately, the sum rules for the different mechanism of momentum transfer in the fluids. The results are expected to be useful in the study of bulk viscosity of the fluids. (author). 9 refs.

15812 (IC–90/352) **Stability diagram of the phase-locked solitons in the parametrically driven, damped non-linear Schroedinger equation.** Barashenkov, I.V. (International Centre for Theoretical Physics, Trieste (Italy)); Bogdan, M.M.; Korobov, V.I. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 12p. Order Number DE91625263. Source: OSTI; NTIS (US Sales Only); INIS.

The problem of activation and stabilization of solitons in real systems with dissipation, is a subject of currently growing interest. In the condensed matter physics the traditional method of exciting nonlinear waves in a medium and compensating dissipative losses consists in applying a high-frequency alternating field. An effective energy transfer from the field to the medium occurs in the case of parametric pumping which the present letter is devoted to. 11 refs, 2 figs.

15813 (INIS-SU–237, pp. 56-57) **Peculiarity of anti-Stokes luminescence from $^4S_{3/2}$ level in $Y_3Al_2O_{12}$-Er^{3+} high concept rated crystals.** Zhekov, V.I. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Murina, T.M.; Popov, A.V.; Prokhorov, A.M. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989. 58p. (In Russian). In *Experimental and theoretical physics: Collection.* Order Number DE91003081. Source: OSTI; NTIS (US Sales Only); INIS.

Anti-Stokes luminescence of Er^{3+} ions in $Y_3Al_5O_{12}$ crystals under excitation in electron-oscillating wings caused by absorption and irradiation of phonons ($^4I_{15/2}$-$^4I_{11/2}$) is studied. It is supposed that absorption in a long-wave spectral region is due to Er^{3+} ions present in crystal macrodefects. 8 refs.; 1 fig.

15814 (INIS-SU–238/A, pp. 9-10) **Anderson carrier localization effect in the Hubbard upper zone on silicon photoconductivity in the submillimeter spectral range.** Murzin, V.N.; Trofimov, I.E. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989. 56p. (In Russian). In *Plasma physics: Collection.* Order Number DE91003082. Source: OSTI; NTIS (US Sales Only); INIS.

Spectra of submillimeter photoconductivity of doped silicon, conditioned by carrier transitions from H^--like impurity states to conductivity are investigated. Concentration threshold of H^--zone formation is determined. 5 refs.; 2 figs.

15815 (INIS-SU–238/A, pp. 24-26) **Study of a-Si:H films implanted with transition metal ions.** Akimchenko, I.P.; Karryev, A.N.; Aleksanyan, S.N. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989. 56p. (In Russian). In *Plasma physics: Collection.* Order Number DE91003082. Source: OSTI; NTIS (US Sales Only); INIS.

Optical properties and structure of a-Si:H films with high concentration of transition metal ion-implanted impurities are investigated. It is supposed that an irreversible decrease of edge luminescence is conditioned by the production of implanted impurity silicide precipitates. 4 refs.; 3 figs.

15816 (IS-T–1506) **Hydrogen diffusion and microstructure in undoped and boron-dope hydrogenated amorphous silicon: An IR and SIMS study.** Mitra, S. Ames Lab., IA (USA). 12 Mar 1991. 133p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-82. Order Number DE91009867. Source: OSTI; NTIS; INIS; GPO Dep.

Thesis submitted to Iowa State University.

Hydrogenated amorphous silicon (a-Si:H) prepared by rf sputtering of a polycrystalline Si target at various rf powers $50 \leq P \leq 550$ W (0.27–2.97 W/cm^2), target to substrate distance $1 \leq d \leq 2''$, and varying hydrogen partial pressures. Doping was accomplished by introducing diborane (B_2H_6) in the plasma. Hydrogen diffusion was studied from the depth profiles obtained from the SIMS on multilayered a-Si:H/a-Si:(H,D)/a-Si:H samples. The properties of the samples were characterized by IR absorption, optical gap measurements and ESR. IR yielded quantitative and qualitative information total hydrogen content and the nature of the hydrogen bonding, respectively. Hence the hydrogen microstructure of the samples could be varied in a systematic manner and monitored from the hydrogen vibrational modes. The ESR gave information on the number of paramagnetic defects per unit volume in the samples. The IR absorption of both as-deposited and annealed samples were closely monitored and the results clearly demonstrate a strong correlation between hydrogen diffusion and its microstructure. It is shown that microvoids in a-Si:H play a critical role in the process of diffusion by inducing deep hydrogen trapping sites that render them immobile. Consequently, as the microvoid density increases beyond a critical density hydrogen diffusion is totally quenched. The diffusion results are discussed both in the context of multiple trapping transport of hydrogen in an exponential distribution of trapping sites and the floating bond model.

15817 (LA-UR–91-854) **Transient thermal analysis for photothermal spectroscopy using Zeeman interferometry.** Hiller, D.B. (Washington State Univ., Pullman, WA (USA). Dept. of Mechanical and Materials Engineering); Johnston, R.G. Los Alamos National Lab., NM (USA). [1991]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. GRANT GM38287. (CONF-9103136–2: 5. national conference on undergraduate research, Pasadena, CA (USA), 21-23 Mar 1991). Order Number DE91009948. Source: OSTI; NTIS; GPO Dep.

A new method of photothermal spectroscopy is introduced for measuring the weak absorption of light by liquids. This paper discusses the analysis for the time-varying Gaussian heating profile induced in a sample by laser heating. The advantages of this new Zeeman technique is that it is experimentally simple, yet less model dependent and at least as sensitive as competing methods. 10 refs., 5 figs.

15818 (LBL–30056) **Canonical vs. micro-canonical sampling methods in a 2D Ising model.** Kepner, J. Lawrence Berkeley Lab., CA (USA). Dec 1990. 38p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. Order Number DE91010204. Source: OSTI; NTIS; INIS; GPO Dep.

Canonical and micro-canonical Monte Carlo algorithms were implemented on a 2D Ising model. Expressions for the internal energy, U, inverse temperature, Z, and specific heat, C, are given. These quantities were calculated over a range of temperature, lattice sizes, and time steps. Both algorithms accurately simulate the Ising model. To obtain greater than three decimal accuracy from the micro-canonical method requires that the more complicated expression for Z be used. The overall difference between the algorithms is small. The physics of the problem under study should be the deciding factor in determining which algorithm to use. 13 refs., 6 figs., 2 tabs.

15819 (LBL–30057) **Possibilities for projection x-ray lithography using holographic optical elements.** Howells, M.R. (Lawrence Berkeley Lab., CA (USA)); Jacobsen, C. Lawrence Berkeley Lab., CA (USA). Dec 1990. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (CONF-9104203–1: Soft-x-ray projection lithography topical meeting, Monterey, CA (USA), 10-12 Apr 1991). Order Number DE91009770. Source: OSTI; NTIS; GPO Dep.

Although there is a considerable literature on proximity x-ray lithography, the interest in projection x-ray techniques has arisen fairly recently, mainly due to the efforts of the AT and T group. The advantages of the projection approach seem to be the elimination of transmission masks and other problems of close proximity, the opportunity for demagnifying a mask of a coarser spatial scale, and, given a rigid, reflection mask, the possibility of cooling. The assumption behind the pursuit of these advantages is that the technical challenges of making the optical system that will perform the projection and the x-ray source that will illuminate it are tractable on some timescale. The optical fabrication tolerances and other design issues involved in carrying out projection using a conventional reflection system have been investigated by Rogers and Jewell. These authors find that the needed tolerances are well beyond the present state of the art even for spherical surfaces and the required surfaces in these schemes are aspheric. In this presentation we present an alternative approach to the process of projection which, of course, has its own, different challenges. It is a matter of one's judgment and technological starting point to decide which one of these (or other) approaches will provide the easiest path to a working x-ray projection lithography.

15820 (NIIYaF-MGU–89-15-92) **Shell potential and its application in sputtering theory.** Kuz'mina, N.M.; Kuz'min, Yu.V. Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki. 1989. 13p. (In Russian). Order Number DE91623660. Source: OSTI; NTIS (US Sales Only); INIS.

Analytical potential permitting to take into account the shell structure of atom at quasiclassical level is suggested. Using the analytical potential the spectrum of recoil atoms appearing in case of bombardment of solid bodies by fast ions has been calculated. 9 refs.; 4 figs.

15821 (OUP–90-30) **Stability and servo-control of the crystal pulling process.** Johansen, T.H. Oslo Univ. (Norway). Fysisk Inst. Nov 1990. 22p. Order Number DE91623615. Source: OSTI; NTIS (US Sales Only); INIS.

The paper analyzes why the crystal pulling process needs servo-control, and how it can be implemented. Special emphasis is put on the fundamental question of inherent stability, and how to interpret the signal from a balance when the weighing method is used for cystal diameter detection. 15 refs., 13 figs.

15822 (PINSTECH/NMD–121) **Behavior of specific heat and self diffusion coefficient of sodium near transition temperature: a molecular dynamics study.** Ahmed, N.; Khan, G. Pakistan Inst. of Nuclear Science and Technology, Islamabad (Pakistan). Nuclear Materials Div. Sep 1990. 28p. Order Number DE91623616. Source: OSTI; NTIS (US Sales Only); INIS.

4 fig.

In this report the author used of a very useful technique of simulation and applied it to successfully for determining the various properties of sodium, both in liquid and solid phase near transition point. As a first step the determination of specific heat and diffusion coefficient have been carried out. In liquid state the molecular dynamics (MD) values calculated matched the experimental data. But in solid state the diffusion coefficient obtained were not consistent with the one expected for a solid, rather the values obtained suggested that sodium remained in liquid state even below the melting point. (A.B.). 4 fig.

15823 (UCRL-JC-105920) **Analysis of electron heat transport in femtosecond laser-plasma interactions with layered solid targets and with thin foils.** Rosen, M.D. Lawrence Livermore National Lab., CA (USA). 10 Jan 1991. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9010298-7: International workshop on radiative properties of hot dense matter, Sarasota, FL (USA), 22-26 Oct 1990). Order Number DE91010153. Source: OSTI; NTIS; INIS; GPO Dep.

We analyze two types of experiments that enhance our knowledge of the electron heat transport in femtosecond laser produced plasmas. The first involves layered targets and the fall off of substrate signal with increasing overlayer thickness. The experiment uncertainties are too large at present to definitively quantify the heat transport. The second involves the radiative output from thin foils. The behavior of the spectral response to foil thickness implies that our understanding of the transport within the foils is quite good. 12 refs., 11 figs.

15824 (UCRL-JC-106476) **Surface electron emission induced by slow multicharged ions.** Bardsley, J.N.; Penetrante, B.M. Lawrence Livermore National Lab., CA (USA). 1 Feb 1991. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9102102-1: Symposium on surface science, Obertraun (Austria), 10-16 Feb 1991). Order Number DE91010469. Source: OSTI; NTIS (US Sales Only); GPO Dep.

At the recent workshop on highly charged ions at Giessen, Hanspeter Winter presented a fascinating paper entitled "What ions experience on their way into a metal surface." The discussion follows the traditional approach which we will term the adiabatic quantum model (AQM). The electrons are drawn from the metal to the ion when the attractive potentials binding electrons to the solid and ionic nucleus overlap and the intervening barrier disappears. For highly charged ions this process, called resonance neutralization, transfers the electrons into orbits with very large principle quantum numbers. These weakly bound electrons then exchange energy through their Coulomb interactions, some rising into continuum states and others falling into more deeply bound levels. The rate at which this process occurs is estimated from Auger rates assuming between stationary quantum states. This is not simple, since there is little information on this process for such high quantum numbers, and very many states are involved. In this talk we will present an alternative picture (CDM) based upon elementary field emission theory and a classical description of the dynamics of the plasma formed by the emitted electrons. Since the quantum level spacings are so low and very little time is spent by each electron in a specific quantum state, we believe that the use of classical dynamics will lead to a more accurate description than could be obtained using quantum theory with current computers. Furthermore, the treatment of the simultaneous interactions between many charged particles is much simpler in classical mechanics. 23 refs., 4 figs.

6561 Superconductivity

Refer also to citation(s) 14703, 14931, 14932, 15197, 15510, 15807

15825 (INIS-SU-232, pp. 28-34) **New method of correlation functions calculation in quantum statistical physics: Part 4. Exact linearization of Bardeen-Cooper-Schrieffer model.** Sarry, M.F. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1988. 43p. (In Russian). In *Theoretical and applied physics: Scientific-technical collection.* Order Number DE91003077. Source: OSTI; NTIS (US Sales Only); INIS.

A new approach to solving the Bardeen-Cooper-Schrieffer superconductivity problem is proposed. In this solution scheme the superconductivity theory remains gap-like, but a diagonal $<\Delta^*\Delta>$ value serves as a gap, while in the Bardeen-Cooper-Schrieffer superconductivity theory a non-diagonal $<\Delta>^2$ value acts as a gap. 7 refs.

15826 (INIS-SU-232, pp. 35-40) **Recombination model of high-temperature superconductivity.** Shklovskij, A.G.; Sedousov, E.E. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1988. 43p. (In Russian). In *Theoretical and applied physics: Scientific-technical collection.* Order Number DE91003077. Source: OSTI; NTIS (US Sales Only); INIS.

Recombination mechanism of high-temperature superconductivity, its advantage consisting in the possibility of the initial model Hamiltonian derivation from the first principles is presented. Only two physically justified approximations are made therewith: it is supposed that high critical temperatures are notably conditioned by anomalously small forbidden zone width in the electron spectrum of superconducting ceramics and it is believed that the recombination part of interelectron Coulomb interaction leads to Cooper pairing. It is shown that for lamellar structures the superconductivity mechanism proposed best of all explains the set of certain experimental facts. 12 refs.

15827 (LA-UR-91-893) **Valence-fluctuation scenario for cuprate superconductivity: The finite-U pairing mechanism.** Brandow, B.H. Los Alamos National Lab., NM (USA). [1991]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910145-2: Electronic structure and mechanisms for high temperature superconductivity, Coral Gables, FL (USA), 3-9 Jan 1991). Order Number DE91009953. Source: OSTI; NTIS; GPO Dep.

The ideal that the normal state of cuprate superconductors is a valence-fluctuation (VF) state is appealing for a number of reasons. We are exploring this scenario quantitatively, focussing especially on the finite-U mechanism for s-wave pairing. The calculations employ a many-body variational technique developed previously for VF and heavy-fermion materials. We are presently exploring the effects of (a) varying the Hamiltonian parameters away from the values obtained from photoemission data analysis, (b) various simple assumptions for the band structure and hybridization k-dependence, and (c) corrections and to the Gutzwiller approximation. These are the topics to be discussed in this report. 17 refs., 1 fig.

15828 (LA-UR-91-939) **Anyons: A possible mechanism for binding charged particles.** Schmeltzer, D. (City Coll., New York, NY (USA). Dept. of Physics); Bishop, A.R. Los Alamos National Lab., NM (USA). [1991]. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910265-2: Texas Center for Superconductivity workshop on the physics and mathematics of anyons, Houston, TX (USA), 1-2 Feb 1991). Order Number DE91009960. Source: OSTI; NTIS; INIS; GPO Dep.

The hard core boson gas in (2+1)-dimensions in the presence of a Chern-Simons term is considered, we find that the long wave description is given in terms of Coulomb (longitudinal) and transversal electrodynamics. The longitudinal part is described in terms of electric charges which carry vorticity. When binding of electrical charges occurs the transversal part is described by a photon field and corresponds to a superfluid. Using the same language we find that a spinless fermion is described by a massive photon. We use these concepts to understand the relation between the negative-U Hubbard model in the presence of a magnetic field, and vortices which carry electric charge induced by doping in the repulsive Hubbard model. 13 refs.

15829 (LA-UR-91-1013) **Quasi-two dimensional density of states and the isotope effect in the superconducting Cu oxides.** Coffey, D.; Schwarz, R.; Yvon, P. Los Alamos National Lab., NM (USA). [1991]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9103112-1: Conference on fermiology of high T_c superconductors, Argonne, IL (USA), 25-27 Mar 1991). Order Number DE91009969. Source: OSTI; NTIS; INIS; GPO Dep.

Tsuei et al. have pointed out that the correlation between a maximium in $T_c$and a minimum in the oxygen isotope exponent, α, observed by Crawford et al. in $La_{2-x}Sr_xCuO_4$ and by Franck et al. in $(Y_{1-x}Pr_x)Ba_2Cu_3O_7$ may be understood as a carrier density of states effect, N(E). We point out here that, if the gap equation is treated in the weak coupling approximation, an N(E) with an enhancement in a narrow range of energies which is symmetric about some energy E_s is sufficient to give the correlation. We discuss

how such as enhancement may arise from a tight-binding description of the CuO planes.

15830 (ORNL/CCIP–91/03) **The t-J model at small t/J: Numerical, perturbative, and supersymmetric results.** Barnes, T. (Oak Ridge National Lab., TN (USA). Center for Computationally Intensive Physics). Oak Ridge National Lab., TN (USA). Center for Computationally Intensive Physics. Feb 1991. 12p. Sponsored by USDOE, Washington, DC (USA); Tennessee State Government, Nashville, TN (USA). DOE Contract AC05-84OR21400 ;AS05-76ER03956. R01-1061-68. (UTK–91/01;CONF-910190–1: Workshop on electronic structures and mechanisms for high temperature superconductivity, Miami, FL (USA), 3-9 Jan 1991). Order Number DE91009921. Source: OSTI; NTIS; INIS; GPO Dep.

We discuss some recent results for one- and two-hole states in the t-J model at small t/J. These include numerical results (bandwidth determinations and accurate t/J values for 4 x 4 lattice one-hole ground-state level crossings), hopping-parameter perturbation theory (which gives the small-t/J one-hole bandwidth in terms of the static-vacancy ground state), and results at the supersymmetric point t/J = 1/2 (exact results for energies and bandwidths.) The perturbative results leads us to a new conjecture regarding the staggered magnetization of higher-spin states in the two-dimensional Heisenberg model. We also discuss extrapolation of small-t/J results to high-$T_c$parameter values; in the two-hole ground states we find $(t/J)^{\lambda}$ behavior in the rms hole-hole separation, and an extrapolation to t/J = 3 gives a bulk-limit rms hole-hole separation of ≈ 7Å. 18 refs., 6 figs.

6570 Theoretical and Mathematical Physics

Refer also to citation(s) 15459, 15460, 15509, 15562, 15645, 15809

15831 (IC–90/70) **Study of some properties of partial differential equations by Lie algebra method.** Chongdar, A.K.; Ludu, A. International Centre for Theoretical Physics, Trieste (Italy). May 1990. 9p. Order Number DE91625191. Source: OSTI; NTIS (US Sales Only); INIS.

In this note we present a system of optimal subalgebras of the Lie algebra obtained in course of investigating hypergeometric polynomial. In addition to this we have obtained some reduced equation and invariants of the P.D.E. obtained under certain transformation while studying hypergeometric polynomial by Weisner's method. Some topological properties of the solutions of P.D.E. are pointed out by using the extended jet bundle formalism. Some applications of our work on plasma physics and hydrodynamics are also cited. (author). 8 refs.

15832 (IC–90/111) **Structure of some relative relation modules of finite p-groups.** Yamin, M. International Centre for Theoretical Physics, Trieste (Italy). Jun 1990. 11p. Order Number DE91625182. Source: OSTI; NTIS (US Sales Only); INIS.

Let G be a finite p-group generated by $(g_i, 1 \leq i \leq d)$, G_i the cyclic subgroup generated by g_i, E the free product of the G_i, $1 \leq i \leq d$, and S the kernel of the natural epimorphism of E onto G. The largest elementary abelian p-quotient S-circumflex = $S/S'S^p$, regarded as an IF_pG-module via conjugation in E, is called a relative relation module of G. If d is the minimum number of generaters for G, the author has proved that S-circumflex is nonprojective and indecomposable. The aim of this paper is to give an alternative proof for the indecomposability of S-circumflex; the proof here is more informative as it deals with Loewy structure and generating sets of S-circumflex and other associated modules. (author). 9 refs.

15833 (IC–90/170) **On a class of general variational inequalities.** Siddiqi, A.H. International Centre for Theoretical Physics, Trieste (Italy). Jun 1990. 13p. Order Number DE91625183. Source: OSTI; NTIS (US Sales Only); INIS.

The study of variational inequalities was initiated by the Italian Mathematician, Guido Stampacchia in the early 60's. Besides several other important problems of Physics and Engineering this theory has been applied to solve the problem of Elasticity with unilateral constraints. In this paper we introduce a new class of variational inequalities and study the existence and uniqueness of its solution. Error estimates, convergence of approximate solution and the penalty method are also discussed. (author). 25 refs.

15834 (IC–90/225) **The chaotic environment.** Cook, A. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 10p. Order Number DE91625184. Source: OSTI; NTIS (US Sales Only); INIS.

An elementary account of the origin of chaotic behaviour in classical dynamics is given with examples from geophysics, and in conclusion some thoughts about what can be predicted of chaotic behaviour and what sorts of arguments can be used to guide human behaviour in chaotic conditions are presented. 4 refs.

15835 (IC–90/249) **On the origin of inertia.** Culetu, H. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 5p. Order Number DE91625207. Source: OSTI; NTIS (US Sales Only); INIS.

A dynamical origin to the Minkowski geometry is suggested in this paper. The Minkowski internal $(-x_{\alpha}x^{\alpha})^{1/2}$ plays the role of the fifth dimension. We found the energy-momentum vector p^{μ} (associated to a "motion in scale") of a "free" relativistic particle in position-dependent. When x_l and "t" are not independent, we are naturally led to the law of inertia. (author). 10 refs.

15836 (IC–90/257) **Harmonic distributions, Diff(S^2) and Virasoro algebra.** Saidi, E.H.; Zakkari, M. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 21p. Order Number DE91625185. Source: OSTI; NTIS (US Sales Only); INIS.

Harmonic distributions on the two sphere are developed and their relation with the complex plane ones is established. the basic harmonic distributions are shown to obey the Cauchy integration rules. Local Cartan tensors on S^2 are introduced. They are analytic functions satisfying a harmonic analyticity condition. Their Laurent expansion is examined and the connection with the complex plane analysis is given. Diff(S^2) and its one parameter gauge subgroups are discussed in the harmonic coordinate system. The derivation of the Virasoro algebra from the one parameter subgroups of Diff(S^2) is worked out in two special cases ($\alpha^{--}.\beta^{++} = 0$). A realization based on Cartan tensors is also given. Finally, we show that there is a 1 : 1 correspondence between the (2,0) supersymmetry on S^2 and the hypermultiplet duality of Galperin et al. (author). 19 refs.

15837 (IC–90/275) **Symmetries of the octonionic root system of E_8.** Koca, M. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 32p. Order Number DE91625186. Source: OSTI; NTIS (US Sales Only); INIS.

Octonionic root system of E_8 is decomposed as the 9 sets of Hurwitz integers, each set satisfying the binary tetrahedral group structure, and the 12 sets of quaternionic units, each set obeying the dicyclic group structure of order 12. This fact is used to prove that the automorphism group of the octonionic root system of E_7 is the finite subgroup of G_2, of order 12096; an explicit 7 x 7 matrix realization of which is constructed. Possible use of the octonionic representation of the E_6 root system as orbifolds and the relevance of the binary tetrahedral structures with the statistical mechanics models are suggested. (author). 16 refs, 6 figs.

15838 (IC–90/288) **On the axially symmetric non-rotating vacuum solutions of Rosen's equations.** Bozhkov, Y. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 9p. Order Number DE91625208. Source: OSTI; NTIS (US Sales Only); INIS.

It is shown that all axially symmetric nonrotating solutions of Rosen's field equations can be expressed in terms of two harmonic functions. It is also shown that the total energy of Rosen's metric is Mc^2. (author). 8 refs.

15839 (IC–90/292) **On correlations of neuronal spike discharges.** Doguwa, S.I. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 19p. Order Number DE91625187. Source: OSTI; NTIS (US Sales Only); INIS.

To assess the dependence structure in two simultaneously occurring stationary spike trains A and B, the cross intensity function, $C_I(t)$ and the pair correlation function g(t) can be very useful. Doss (1989) provides an estimate of $C_I(t)$ at a finite number of points. However, this estimator does not take into consideration the bounded nature of the sampling interval β. Two new boundary corrected estimators are proposed. These two estimators have a

much smaller bias and mean squared error than the existing alternative. The spike discharges recorded simultaneously from a pair of auditory nerve fibres are analyzed using the new estimators. (author). 7 refs, 5 figs.

15840 (IC–90/299) **The Wess-Zumino-Witten models on N-punctured Riemann sphere.** Chang Zhe. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 14p. Order Number DE91625188. Source: OSTI; NTIS (US Sales Only); INIS.

WZW models on the N-punctured Riemann sphere S^2 are discussed. The Ward identity is derived. According to Riemann-Roch theorem, we construct a basis of meromorphic λ differentials. The expanding coefficients of the stress-energy tensor and currents are expressed by the meromorphic $\lambda = -1$ and $\lambda = 0$ differentials. Thus multi-pole Virasoro and Kac-Moody algebra are obtained. A highest-weight representation of the combined multi-pole Kac-Moody and Virasoro algebra are generated. (author). 11 refs.

15841 (IC–90/301) **Variational problems with obstacles and harmonic maps.** Musina, R. International Centre for Theoretical Physics, Trieste (Italy). Aug 1990. 11p. Order Number DE91625189. Source: OSTI; NTIS (US Sales Only); INIS.

Our first purpose is to find a generalization of the usual definition of a harmonic map between two Riemannian manifolds in order to consider less regular target spaces. Our second aim was to extend a result by Chen and Struwe about the heat flow of harmonic mappings into manifolds with boundary. 19 refs.

15842 (IC–90/307) **Is the Hawking wormhole responsible for the Rindler particles?.** Culetu, H. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 8p. Order Number DE91625209. Source: OSTI; NTIS (US Sales Only); INIS.

It is assumed that an inertial observer perceives the Minkowski spacetime as if it were full of Hawking wormholes. The spacetime becomes static to an hyperbolic observer. It is shown that the Ricci tensor has sharp variations near the horizons. The properties of the corresponding stress tensor are analyzed. (author). 10 refs, 2 figs.

15843 (IC–90/312) **Quantum gravitational corrections to the functional Schroedinger equation.** Kiefer, C. (Zurich Univ. (Switzerland). Inst. fuer Theoretische Physik); Singh, T.P. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 18p. Order Number DE91625192. Source: OSTI; NTIS (US Sales Only); INIS.

We derive corrections to the Schroedinger equation which arise from the quantization of the gravitational field. This is achieved through an expansion of the full functional Wheeler-DeWitt equation with respect to powers of the Planck mass. We demonstrate that the corrections terms are independent of the factor ordering which is chosen for the gravitational kinetic term. Although the corrections are numerically extremely tiny, we show how they lead, at least in principle, to shift in the spectral lines of hydrogen type atoms. We discuss the significance of these corrections for quantum field theory near the Planck scale. (author). 35 refs.

15844 (IC–90/313) **Relativistic dynamical reduction models and nonlocality.** Ghirardi, G.C. (International Centre for Theoretical Physics, Trieste (Italy)); Grassi, R.; Pearle, P. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 16p. Order Number DE91625193. Source: OSTI; NTIS (US Sales Only); INIS.

We discuss some features of continuous dynamical models yielding state vector reduction and we briefly sketch some recent attempts to get a relativistic generalization of them. Within the relativistic context we analyze in detail the local an nonlocal features of the reduction mechanism and we investigate critically the possibility of attributing objective properties to individual systems in the micro and macroscopic cases. At the nonrelativistic level, two physically equivalent versions of continuous reduction mechanisms have been presented. However, only one of them can be taken as a starting point for the above considered relativistic generalization. By resorting to counterfactual arguments we show that the reason for this lies in the fact that the stochasticity involved in the two approaches has different conceptual implications. (author). 7 refs, 4 figs.

15845 (IC–90/315) **Electric moments induced by a (time periodic) current density.** Radescu, E.E. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 8p. Order Number DE91625194. Source: OSTI; NTIS (US Sales Only); INIS.

The frequency (ω) dependent nondiagonal (electric-toroid) dipole polarizability $g(\omega)$ of a (nonrelativistic, spinless, ground-state) hydrogenlike atom, which yields the strength of the (time periodic) electric dipole moment induced in the atom by an external conduction or displacement (time periodic) current density, is calculated exactly in terms of a Gauss hypergeometric function. Although $g(\omega = 0) = 0$, the derivative $g'(\omega = 0) = -19a_0^5/6Z^6$ (a_0 = Bohr radius, Z = charge number) is responsible for a certain part of the low energy elastic scattering of light on the atom. (author). 8 refs.

15846 (IC–90/319) **Toroid polarizabilities and the elastic scattering of photons by atomic hydrogen.** Radescu, E.E. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 8p. Order Number DE91625195. Source: OSTI; NTIS (US Sales Only); INIS.

In the framework of an exactly soluble case, that of a (nonrelativistic, spinless, ground-state) hydrogenlike atom, it is shown in a way unbiased by approximations that alongside with the usual (dipole and quadrupole) electric polarizabilities, and Langevin-type (dipole and quadrupole) magnetic polarizabilities, two other polarizabilities of a new type, called "toroid" (already introduced in previous work) are required in order to correctly establish the low energy behaviour of the Rayleigh amplitude to the fourth order in the photon's frequency. A longstanding puzzle in the understanding of the interconnection between quantum mechanical functions (polarizabilities) and the amplitude for the elastic scattering of photons by atoms is thereby, in principle, finally removed. (author). 8 refs.

15847 (IC–90/334) **Physical meaning of the optical reference geometry.** Abramowicz, M.A. International Centre for Theoretical Physics, Trieste (Italy). Sep 1990. 11p. Order Number DE91625210. Source: OSTI; NTIS (US Sales Only); INIS.

I show that contrary to a popular misconception the optical reference geometry, introduced a few years ago as a formally possible metric of a 3-space corresponding to a static spacetime, is quite satisfactory also from the physical point of view. The optical reference geometry has a clear physical meaning, as it may be constructed experimentally by measuring light round travel time between static observers. Distances and directions in the optical reference geometry are more strongly connected to experiment than distances and directions in the widely used directly projected metric (discussed e.g. in Landau and Lifshitz textbook.) In addition, the optical reference geometry is more natural and convenient than the directly projected one in application to dynamics. In the optical geometry dynamical behaviour of matter is described by concepts and formulae identical to those well known in Newtonian dynamics on a given two dimensional (curved) surface. (author). 22 refs.

15848 (IC–90/341) **Optimization and resolution of Lourie's equations.** Nguyen Cang (Universite de Ho Chi Minh Ville, Ho Chi Minh Ville (Viet Nam). Dept. de Mathematiques); Nguyen Kim Tan. International Centre for Theoretical Physics, Trieste (Italy). Oct 1990. 11p. (In French). Order Number DE91625190. Source: OSTI; NTIS (US Sales Only); INIS.

Assuming that the optimal control of the system considered by Popov is established, it is demonstrated that the Lourie equations are soluble. 4 refs.

15849 (IFVE-OTF–89-118) **The underlying principles of relativistic theory of gravitation.** Logunov, A.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 11p. Order Number DE91623492. Source: OSTI; NTIS (US Sales Only); INIS.

The paper deals with the main statements of relativistic theory of gravitation, constructed in result of critical analysis of the general theory of relativity. The principle of geometrization is formulated.

15850 (IFVE-OTF–89-142) **Gravitational collapse of dust in the relativistic theory of gravity.** Chugreev, Yu.V. (Moskovskij Gosudarstvennyj Univ., Moscow (USSR). Nauchno-Issledovatel'skij Inst. Yadernoj Fiziki). Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 35p. (In Russian). Order Number DE91623493. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to the journal EhChaYa.

It is shown, that gravitational collapse in the relativistic theory of gravity with nonzero rest mass of gravitation principally differs from that one in massless theory. Near the Schwarzschild horizon the collapsing dust sphere reboundas. 13 refs.; 2 figs.

15851 (IFVE-OTF–89-143) **Gravitational waves on the cosmological background in relativistic theory of gravitation with nonzero rest mass of graviton.** Chugreev, Yu.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 22p. (In Russian). Order Number DE91623494. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted to the journal Teor. Mat. Fiz.

In the frameworks of relativistic theory of gravitation with nonzero graviton rest mass theory of gravitational wave radiation is built with the source being embeded in infinite and oscillating Friedmann Universe. If the source has a nonzero quadrupole moment intensity of radiation is described by usual quadrupole formula, otherwise (spherically symmetric case) the intensity is strongly suppressed but positive. 10 refs.

15852 (IFVE-OTF–89-193) **New examples of continuum graded Lie algebras.** Savel'ev, M.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij); Vershik, A.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov (USSR). Inst. Fiziki Vysokikh Ehnergij. 1989. 16p. Order Number DE91623480. Source: OSTI; NTIS (US Sales Only); INIS.

Several new examples of continuum graded Lie algebras which provide an additional elucidation of these algebras are given. Here, in particular, the Kac-Moody algebras, the algebra S_0 Diff T^2 of infinitesimal area-preserving diffeomorphisms of the torus T^2, the Fairlie, Fletcher and Zachos sine-algebras, etc., are described as special cases of the cross product Lie algebras. 8 refs.

15853 (ITEP–133-89) **Interaction of gravity and matter in the framework of N=4 supersymmetry.** Terent'ev, M.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 8p. Order Number DE91623495. Source: OSTI; NTIS (US Sales Only); INIS.

Procedure of constructing interaction of gravitation with only one non-Abelian matter multiplet is described. Compactification of 10-dimensional space R_D(D=10) to R_4 space in the framework of N=1 supergravity theory was used. 14 refs.

15854 (ITEP–148-89) **On the concept of universal W-algebra.** Morozov, A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 21p. Order Number DE91623481. Source: OSTI; NTIS (US Sales Only); INIS.

Ordinary quadratic W_N-algebras are in fact particular subsets of naturally closed algebras of Casimir-like operators TrJ^n, formed from generators J of Sl(N) Kac-Moody algebra. These subsets arise after Hamiltonian reduction and some additional less universal restrictions, specifying non-reducible closed subalgebra and ignored in the text. In the limit of $N=\infty$ a structure of linear Lie algebra is restored and a new object arises, naturally interpreted as universal W-algebra. 14 refs.

15855 (ITEP–163-89) **Once more about the topologically massive gauge theory.** Kogan, Ya.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 23p. Order Number DE91623482. Source: OSTI; NTIS (US Sales Only); INIS.

The general properties of the three-dimensional gauge theory with the topological mass is discussed namely the long-range interaction of the Aharonov-Bohm type. It is argued that Chern-Simons gauge theories must be considered as the infrared limit of the topologically massive theories. The analogy between the Landau problem of a charged particle in a magnetic field and quantization of this gauge theory is considered, as well as the quantization condition for the Abelian Chern-Simons term. 38 refs.; 5 figs.

15856 (IYaF–89-93) **Theory of diffusion photoeffect in hydrogen atom. Part 4,5: 4. ionization of a three-dimensional atom in a monochromatic field. 5. Diffusion excitation in two- and three-frequency field.** Shepelyanskij, D.L. AN SSSR, Novosibirsk (USSR). Inst. Yadernoj Fiziki. 1989. 68p. (In Russian). Order Number DE91625196. Source: OSTI; NTIS (US Sales Only); INIS.

Excitation of hydrogen atom in linearly and elliptical polarized fields is considered. It is shown that excitation localization in a two-dimensional hydrogen atom model is the same, as in the one-dimensional case. In this case strong excitation inside the shell does not affect energy localization due to Coulomb degeneration. The conclusion is made that the effect of quantum localization of dynamic chaos can be observed in the laboratory experiment. 26 refs.; 23 figs.

15857 (JINR-R–2-89-533) **Phase space structure in gauge theories.** Shabanov, S.V. Joint Inst. for Nuclear Research, Dubna (USSR). 1989. 88p. (In Russian). Order Number DE91623483. Source: OSTI; NTIS (US Sales Only); INIS.

The lectures are devoted to the new aspect of dynamical systems with gauge groups, the phase space reduction of physical degrees of freedom. The physical phase space structure in many models with a gauge symmetry and with commuting and anticommuting variables, including Yang-Mills fields and Glashow-Weinberg-Salam model, is studied. Some physical consequences of the phase space reduction are discussed. 51 refs.; 15 figs.; 1 tab.

15858 (LA-UR–91-226) **The statistical properties of electromagnetic fields with application to radiation and scattering.** Lehman, T.H. (Lehman (T.H.), Albuquerque, NM (USA)); Miller, E.K. Los Alamos National Lab., NM (USA). [1991]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9106118–1: 1991 Institute of Electrical and Electronics Engineers (IEEE) AP-S symposium, Ontario (Canada), 24-28 Jun 1991). Order Number DE91007467. Source: OSTI; NTIS; INIS; GPO Dep.

Determining the relationships between different average values is an important step in any physics-based statistical theory. If these relationships exist and exhibit certain properties, then probability densities or distributions can be assigned to the field variables and the transition from an "average-value theory" to a "statistical theory" is complete. For electromagnetics, no such average-value relationships have been demonstrated to exist. The derivation of these relationships and their range of validity are the subject of consideration here. For purposes of this discussion, we limit our attention to the fields inside a complex cavity, but with the ultimate goal of deriving the statistics of the far radiated and scattered fields of complex envelopes.

15859 (NBI-HE–90-71) **Is there a minimum length in D=4 lattice quantum gravity?.** Greensite, J. Niels Bohr Inst., Copenhagen (Denmark). Nov 1990. 12p. Contract DE-AC03-81ER400009. Order Number DE91623496. Source: OSTI; NTIS (US Sales Only); INIS.

It is argued that, as in string theory, a minimum length exists in D=4 quantum gravity. The argument is based on a (naive) lattice regularization of tetrad gravity, where it appears that any formal reduction of the lattice spacing $\epsilon=\chi_{n+1}-\chi_n$ is countered by an increase in metric fluctuations. In D=4 dimensions, these fluctuations prevent the average physical separation between neighboring lattice points from falling below a certain minimum, which is on the order of the Planck length. (orig.).

15860 (NBI-HE–90-72) **Three-dimensional simplicial quantum gravity and generalized matrix models.** Ambjoern, J. (Niels Bohr Inst., Copenhagen (Denmark)); Durhuus, B.; Jonsson, T. Niels Bohr Inst., Copenhagen (Denmark). Nov 1990. 16p. Order Number DE91623497. Source: OSTI; NTIS (US Sales Only); INIS.

We consider a discrete model of Euclidean quantum gravity in three dimensions based on a summation over random simplicial manifolds. We derive some elementary properties of the model and discuss possible 'matrix' models for 3d gravity. (orig.).

15861 (NBI-HE–90-76) **2D gravity, random surfaces and all that.** Ambjoern, J. Niels Bohr Inst., Copenhagen (Denmark). Nov 1990. 19p. (CONF-901072–: LATTICE '90: 7th international lattice gauge theory conference, Tallahassee, FL (USA), 8-12 Oct 1990).

Order Number DE91623498. Source: OSTI; NTIS (US Sales Only); INIS.

I review the recent progress in 2d gravity and discuss the new numerical simulations for 2d gravity and for random surfaces in d>2. The random surface theories of interest in d>2 have extrinsic curvature terms, and for a finite value of the extrinsic curvature coupling there seems to be a second order phase transition where the string tension scales. (orig.).

15862 (NIKHEF-H-91-03) **Ashtekar formalism with real variables.** Kalau, W. (University of Wuppertal (Federal Republic of Germany). Physics Department). Nationaal Inst. voor Kernfysica en Hoge-Energiefysica (NIKHEF), Amsterdam (Netherlands). Sectie H. Dec 1990. 14p. Order Number DE91625211. Source: OSTI; NTIS (US Sales Only); INIS.

A new approach to canonical gravity is presented which is based on the Ashtekar formalism. But, in contrast to Ashtekar's variables, this formulation does not need complex quantities nor does it lead to second class constraints. This is achieved using SO(3,1) as a gauge group instead of complexified SO(3). Because of the larger group additional first class constraints are needed which turn out to be cubic and quartic in the momenta. (author). 13 refs.

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Refer also to citation(s) 14417, 15831

15863 (DOE/ER-0493T) **Computing for magnetic fusion energy research: The next five years: A report of the Fusion Computing Council for the Magnetic Fusion Energy Research Community.** Mann, L. (Los Alamos National Lab., NM (USA)); Glasser, A.; Sauthoff, N. (eds.). USDOE Office of Energy Research, Washington, DC (USA). Office of Fusion Energy. 8 Feb 1991. 44p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91010686. Source: OSTI; NTIS; INIS; GPO Dep.

This report considers computing needs in magnetic fusion for the next five years. It is the result of two and a half years of effort by representatives of all aspects of the magnetic fusion community. The report also factors in the results of a survey that was distributed to the laboratories and universities that support fusion. There are four areas of computing support discussed: theory, experiment, engineering, and systems.

15864 (INIS-SU-240) **Thermonuclear synthesis: Scientific-technical collection.** Voprosy atomnoj nauki i tekhniki. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989 75p. (In Russian). Order Number DE91003079. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers in this collection are indexed.

7001 Plasma Research

Refer also to citation(s) 15927, 15950, 15983

15865 (AEA-FUS-33) **The effects of radial transport on current drive in tokamaks.** O'Brien, M.R.; Cox, M.; McKenzie, J.S. AEA Fusion, Culham (UK). [1990]. 14p. Order Number DE91625286. Source: OSTI; NTIS (US Sales Only); INIS.

The influence of radial transport of electrons on radiofrequency and Ohmic current drive in tokamaks is discussed. It is found that such processes can reduce the efficiency of current drive in tokamaks in which the energy confinement time is comparable with or less than the collision time of the heated electrons, and that even if this is not the case they significantly broaden the driven current profile. (author).

15866 (AEA-FUS-75) **The Braginskii fluid stability of reversed field pinches.** Cox, P.M. AEA Fusion, Culham (UK). [1990]. 45p. Order Number DE91625287. Source: OSTI; NTIS (US Sales Only); INIS.

Numerical results are presented concerning the linear stability of the current and future generations of RFP's (reversed field pinches). Resistive MHD (magnetohydrodynamics) indicates that finite beta RFP equilibria are unstable to resistive-g modes, and therefore indicates that these may be responsible for confinement degradation. However, as RFP's become more collisionless, terms that are neglected in resistive MHD become significant and should be included in any stability analysis. In this paper, a linear initial value-code has been used to examine the effect of additional terms in the Braginskii equations on the stability of a tearing mode stable equilibrium. In order to make contact with analytical work the additional physics is introduced term by term. The Hall terms alone are shown to stabilise resistive-g modes, but also to destabilise a variant of the eta_i-mode. When electron thermal conductivities are also included the eta_i-mode remains largely unaffected but the resistive-g mode is no longer stabilised, instead it evolves into a drift-tearing mode that is driven by the electron temperature gradient. Thus in the cold ion limit there are two identifiable branches of instability. The growth-rate of the drift tearing mode is slowed by finite Larmor radius effects, but both it and the eta_i-mode remain unstable throughout the collisional ion regime for which the fluid equations are valid. (author).

15867 (AEA-FUS-76) **Solution of three dimensional Fokker-Planck equations for tokamak plasmas using an operator splitting technique.** McKenzie, J.S.; O'Brien, M.R.; Cox, M. AEA Fusion, Culham (UK). [1990]. 23p. Order Number DE91625329. Source: OSTI; NTIS (US Sales Only); INIS.

A two-stage operator splitting algorithm has been used to time advance the three dimensional Fokker-Planck equation for the electron distribution function in a tokamak. In the first stage, derivatives in two of the dimensions are advanced together implicitly. Derivatives in the remaining dimension are advanced in the second stage. This algorithm gives accurate solutions in modest CPU times unlike alternative schemes considered. We describe the technique which includes features that accommodate the internal boundary conditions arising from trapped electron effects. (author).

15868 (AEA-FUS-77) **Toroidal effects on the non-linearly saturated m = 1 island in tokamaks.** Avinash, K.; Haas, F.A.; Thyagaraja, A. AEA Fusion, Culham (UK). [1990]. 8p. Order Number DE91625330. Source: OSTI; NTIS (US Sales Only); INIS.

This paper investigates the influence of toroidal effects (due to the coupling of various poloidal harmonics) on the non-linear saturation of the m=1 island. Bounds are obtained relating the aspect ratio, the shear at the q=1 surface and the saturated island width. Provided these bounds are satisfied, then we find that the cylindrical m=1 island theory is valid for toroidal geometry. (author).

15869 (CONF-890931-10) **Comparison of particle-in-cell and Fokker-Planck methods as applied to the modeling of auxiliary-heated mirror plasmas.** Procassini, R.J. (California Univ., Berkeley, CA (USA). Electronics Research Lab.); Birdsall, C.K.; Cohen, B.I.; Matsuda, Yoshi. California Univ., Berkeley, CA (USA). Electronics Research Lab.; Lawrence Livermore National Lab., CA (USA). [1989]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG03-90ER54079 ;FG03-86ER53220 ;W-7405-ENG-48. From 13. conference on the numerical simulation of plasmas; Santa Fe, NM (USA); 17-20 Sep 1989. Order Number DE91009835. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. TMX DEVICES/plasma simulation; FOKKER-PLANCK EQUATION; ECR HEATING; COMPARATIVE EVALUATIONS

15870 (CONF-890931-11) **Multi-scale particle simulation of bounded plasmas.** Parker, S.E. (California Univ., Berkeley, CA (USA). Electronics Research Lab.); Birdsall, C.K.; Friedman, A.; Ray, S.L. California Univ., Berkeley, CA (USA). Electronics Research Lab.; Lawrence Livermore National Lab., CA (USA). [1989]. 4p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA). DOE Contract FG03-90ER54079 ;FG03-86ER53220 ;W-7405-ENG-48. N00014-85-K-0809. From 13. conference on the numerical simulation of plasmas; Santa Fe, NM (USA); 17-20 Sep 1989. Order Number DE91009834. Source: OSTI; NTIS; INIS; GPO Dep.

We are using the multi-scale technique to model bounded systems. Certain bounded systems are a naturally suited for the multi-scale method because of the boundary layer that forms at the wall, which is usually a short spatial and time scale structure, can

significantly affect the bulk plasma behavior. One goal is to understand the interaction between the bulk plasma and the sheath. If the relevant short time scale physics is local to a few known spatial regions, then one can take advantage of this by advancing particles with variable Δt depending on position, hence reducing computing time. The unmagnetized sheath problem is such a case. The model is a one dimensional bounded slab with kinetic ions and electrons. We start with a collisionless and unmagnetized system for simplicity. The right boundary is a conducting wall that absorbs all particles that come in contact with it. The left boundary is a symmetry point, where the particles are reflected. We allow a specified initial distribution: $f(x,v,t = 0)$. In order to test the numerics of both multi-scale method and boundary conditions we are using the following test problem: a cutoff Maxwellian distribution for the electrons and fixed ions. The system has an analytic solution, so the run may be started from equilibrium. This gives us a benchmark and tests the fast time scale electron sheath dynamics. Results using variable Δt will be given. In the future, we intend to use the more general model to study time dependent bounded plasma problems, such as a plasma expanding toward a conducting wall.

15871 (CONF-890931–12) **PDC1: One dimensional radial code for a cylindrical plasma device with an external RLC circuit.** Alves, M.V.; Vahedi, V.; Birdsall, C.K. California Univ., Berkeley, CA (USA). Electronics Research Lab. [1989]. 4p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA). DOE Contract FG03-90ER54079 ;FG03-86ER53220. Contract N00014-85-K-0809. From 13. conference on the numerical simulation of plasmas; Santa Fe, NM (USA); 17-20 Sep 1989. Order Number DE91009833. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. PLASMA SIMULATION/p codes; PLASMA SCRAPE-OFF LAYER/plasma simulation; CYLINDRICAL CONFIGURATION; ELECTRIC FIELDS; COMPUTER GRAPHICS

15872 (CONF-890931–15) **A particle-in-cell method for modeling small angle Coulomb collisions in plasmas.** Parker, S.E. California Univ., Berkeley, CA (USA). Electronics Research Lab. [1989]. 4p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA). DOE Contract FG03-90ER54079 ;FG03-86ER53220. N00014-85-K-0809. From 13. conference on the numerical simulation of plasmas; Santa Fe, NM (USA); 17-20 Sep 1989. Order Number DE91009830. Source: OSTI; NTIS; INIS; GPO Dep.

We propose a computational method to self-consistently model small angle collisional effects. This method may be added to standard Particle-In-Cell (PIC) plasma simulations to include collisions, or as an alternative to solving the Fokker-Planck (FP) equation using finite difference methods. The distribution function is represented by a large number of particles. The particle velocities change due to the drag force, and the diffusion in velocity is represented by a random process. This is similar to previous Monte-Carlo methods except we calculate the drag force and diffusion tensor self- consistently. The particles are weighted to a grid in velocity space and associated "Poisson equations" are solved for the Rosenbluth potentials. The motivation is to avoid the very time consuming method of Coulomb scattering pair by pair. First the approximation for small angle Coulomb collisions is discussed. Next, the FP-PIC collision method is outlined. Then we show a test of the particle advance modeling an electron beam scattering off a fixed ion background. 4 refs.

15873 (CONF-910609–1) **Biasing experiments on the ATF torsatron.** Uckan, T. (Oak Ridge National Lab., TN (USA)); Baylor, L.R.; Bigelow, T.; England, A.C.; Harris, J.H.; Isler, R.C.; Jernigan, T.C.; Lyon, J.F.; Mioduszewski, P.K.; Murakami, M.; Rasmussen, D.A.; Wilgen, J.B.; Wing, W.R.; Aceto, S.C.; Zielinski, J.J.; Bell,Oak Ridge National Lab., TN (USA). [1991]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 18. European conference on controlled fusion and plasma physics; Berlin (Germany, F.R.); 3-7 Jun 1991. Order Number DE91010145. Source: OSTI; NTIS; INIS; GPO Dep.

Recent biasing experiments on tokamaks have been very successful in improving the global particle (H-mode-like) confinement resulting from the setup of an outward-pointing radial electric field at the edge. These experiments have been extended to the current-free Advanced Toroidal Facility (ATF), and initial biasing experiments have been carried out in electron-cyclotron-heated (ECH) plasmas. ATF has a torsatron configuration with $\ell = 2$, 12 field periods ($M = 12$), a major radius $R_0 = 2.1$ m, and an average plasma radius $a = 0.27$ m. The current-free magnetic configuration of ATF that is produced by external means has moderate shear; the rotational transform ($\chi = 1/q$, where q is the safety factor) at the last closed flux surface (LCFS) is $\chi \approx 1$, which is about a factor of 3 higher than the central value. ECH plasmas are created at a magnetic field $B = 0.95$ T using a 53-GHz gyrotron source with heating power up to $P \sim 400$ kW. In these ECH plasmas, a representative line-averaged plasma density is $\bar{n}_e \sim 5 \times 10^{12}$ cm^{-3}, and the plasma stored energy $W_p \approx 2$ kJ. A pair of rail limiters, which are normally floating, one at the top and one at the bottom of the device, are biased at positive and negative potentials with respect to the vessel. 7 refs., 5 figs.

15874 (CONF-910609–2) **Ion confinement and radiation losses in the Advanced Toroidal Facility.** Isler, R.C. (Oak Ridge National Lab., TN (USA)); Colchin, R.J.; Wade, M.R.; Lyon, J.F.; Fowler, R.H.; Rome, J.A.; Hiroe, S.; Baylor, L.R.; England, A.; Ma, C.H.; Rasmussen, D.A.; Ochando, M.; Paul, S. Oak Ridge National Lab., TN (USA). [1991]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 18. European conference on controlled fusion and plasma physics; Berlin (Germany, F.R.); 3-7 Jun 1991. Order Number DE91010382. Source: OSTI; NTIS; INIS; GPO Dep.

Collapses of stored energy are typically observed in low-density ($\bar{n}_e \approx 10^{13}$ cm^{-3}) extensively gettered ATF plasmas when the electron density rises to the ECH cutoff point, and the central heating is supplied only by neutral- beam-injection (NBI). However, the decline of stored energy can be avoided if the density is raised rapidly to about 5×10^{13} cm^{-3}. Three mechanisms have been proposed to explain the collapses: (1) impurity radiation, (2) excitation of an electron instability driven by the neutral beams, or (3) poor coupling of the beam ions to the thermal plasmas. Detailed spectroscopic studies of plasma cleanliness as a function of the gettering procedure have shown that radiation is an unlikely candidate for initiating collapses, although it may become an important loss mechanism once the electron temperature has fallen to a low level. No specific electron instability has yet been identified with injection, but recent experimental and computational work indicates that losses by shinethrough and charge exchange strongly influence the evolution of low-density plasmas. This report discusses the beam particle losses, thermal ions, and the evolution of radiation profiles.

15875 (CONF-910609–3) **Heavy ion beam probe measurements of ECH method plasma in the Advanced Toroidal Facility.** Aceto, S.C. (Rensselaer Polytechnic Inst., Troy, NY (USA)); Schwelberger, J.G.; Zielinski, J.J.; Connor, K.A.; Crowley, T.P.; Heard, J.W.; Hickok, R.L.; McLaren, P.E.; Ouroua, A. Schoch, P.M.; Simcic, V.J.; Isler, R.C.; Harris, J.; Murakami, M.; Glowienka,Oak Ridge National Lab., TN (USA). [1991]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 18. European conference on controlled fusion and plasma physics; Berlin (Germany, F.R.); 3-7 Jun 1991. Order Number DE91010391. Source: OSTI; NTIS; INIS; GPO Dep.

A Heavy Ion Beam Probe (HIBP) has been installed on the Advanced Toroidal Facility (ATF) and used to measure the plasma potential and also make density fluctuation measurements during ECH plasmas. The initial results of the potential profile measurements are presented and related to spectroscopic rotation measurements using simple momentum balance equations. Also, a summary of the density fluctuation measurements made to date is given along with a brief comparison with similar HIBP measurements made on the TEXT tokamak. 6 refs., 3 figs.

15876 (CONF-910609–4) **ICRF heating on the burning plasma experiment (BPX).** Batchelor, D.B. (Oak Ridge National Lab., TN (USA)); Carter, M.D.; Goulding, R.H.; Hoffman, D.J.; Jaeger, E.F.; Ryan, P.M.; Swain, D.W.; Tolliver, J.S.; Yugo, J.J.; Goldston, R.J.; Hosea, J.C.; Kaye, S.M.; Phillips, C.K.; Wilson, J.R.; Scharer, J.E.; Mau,.Oak Ridge National Lab., TN (USA). [1991]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 18. European conference on controlled fusion and plasma physics; Berlin (Germany, F.R.); 3-7

Jun 1991. Order Number DE91010390. Source: OSTI; NTIS; INIS; GPO Dep.

RF power in the ion cyclotron range of frequencies (ICRF) has been chosen as the primary heating technique for BPX. This decision is based on the wide success of ICRF heating in existing experiments (JET, TFTR, JT-60), the capability of ion cyclotron waves to penetrate the high-density plasmas of BPX, the ability to concentrate ICRF power deposition near the plasma center, and the ready availability of high-power sources at the appropriate frequency. The primary task of the ICRF system is to heat the plasma to ignition. However, other important roles are envisaged; these include the stabilization of sawteeth, preheating of the plasma during current ramp-up, and possible control of the plasma current profile by means of fast-wave current drive. We give a brief overview of the RF system, describe the operating scenarios planned for BPX, and discuss some of the antenna design issues for BPX. 4 refs., 3 figs.

15877 (DOE/ER/53198–169) **q-Dependence of magnetic turbulence in a tokamak.** Prager, S.C.; Dexter, R.N.; Graessle, D.E. Wisconsin Univ., Madison, WI (USA). Dept. of Physics. Jan 1991. 53p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-85ER53198. Order Number DE91009679. Source: OSTI; NTIS; INIS; GPO Dep.

Low-frequency radial magnetic field turbulence has been measured over the full minor radius for discharges in the Tokapole 2 tokamak, and scaled over the range of edge safety factor $0.6 \leq q_a \leq 5.0$. It was found that q_a served as a control parameter for both the magnetic fluctuation amplitude and the global confinement time. As q_a is reduced from 5 to 0.6 the turbulence level increases by a factor of fifty while the confinement time decreases by more than a factor of ten. At $q_a \leq 1$, the full fluctuation amplitude is roughly large enough to account for the global confinement using simple estimates of collisionless stochastic magnetic transport. At high q_a, the turbulence is too small to account for transport using these estimates. Frequency spectra have been obtained from 10 to 400 kHz. For all q_a most of the fluctuation power appears below 100 kHz. This low-frequency structure changes as the safety factor is varied. Although broadband in frequency, the long radial coherence lengths at these frequencies indicate global modes. For $f \geq$ 100 kHz, the spectra become featureless, with a power-law frequency decay. Radial, poloidal, and parallel correlation analysis has been done as well. The parallel correlation length is estimated to be 150 ± 10 cm. Radial and poloidal coherence lengths are of the order of the machine dimensions for frequencies below 100 kHz for all q_a. Poloidal mode number spectral information is obtained from two-point phase shift measurements, radial decay of fluctuations beyond the separatrix, and poloidal coherence measurements. The m-spectrum broadens as q_a decreases. This might explain the increase in fluctuation amplitudes as q_a decreases. It is suggested that the turbulence for all discharges is due to the same underlying cause or set of causes, and that the differences result from geometric effects associated with the variation in q_a.

15878 (DOE/ER/53223–158) **Hall effects on anomalous heat, particle and helicity transports through tearing-mode turbulence.** Yoshida, Z.; Strauss, H.R.; Hameiri, E. New York Univ., NY (USA). Courant Inst. of Mathematical Sciences. Jan 1991. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-86ER53223. (MF–122). Order Number DE91010730. Source: OSTI; NTIS; INIS; GPO Dep.

The helicity transport in a current-carrying plasma results in heat and particle transports in the direction opposite to the helicity flux. Tearing-mode turbulence produces helicity flux that is proportional to the gradient of equilibrium parallel current. The helicity flux is a consequence of a fluctuating electric field with a circularly polarized component, which also causes a nonlinear parallel current (primarily an electron flux) and a nonlinear polarization current (primarily an ion flux). Such anomalous heat and particle fluxes are driven by the free-energy associated with the perturbed magnetic field in the tearing-mode turbulence, and are typically directed inward to the plasma. Both fluxes becomes large when the gradient of the equilibrium current is large. 12 refs.

15879 (DOE/ER/53266–30) **On standard forms for transport equations and fluxes: Part 2.** Ross, D.W. Texas Univ., Austin, TX (USA). Fusion Research Center. Mar 1990. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-88ER53266. (FRCR–357). Order Number DE91010421. Source: OSTI; NTIS; INIS; GPO Dep.

Quasilinear expressions for anomalous particle and energy fluxes arising from electrostatic plasma turbulence in a tokamak are reviewed yet again. Further clarifications are made, and the position taken in a previous report is modified. There, the total energy flux, Q_j, and the conductive heat flux, q_j, were correctly defined, and the anomalous Q_j was correctly calculated. It was shown that the anomalous energy transport can be correctly described by $\nabla \cdot Q^*_j$, where $Q^*_j = 3/5\ Q_j$, with all remaining source terms such as $\{\tilde{p}_j \nabla \cdot \tilde{V}j\}$ cancelling. Here, a revised discussion is given of the identification of the anomalous conductive flux, q_j, in which the distinction between Q_j and Q^*_j is reconsidered. It is shown that there is more than one consistent way to define q_j. Transport calculations involving only theoretical electrostatic turbulent fluxes are unaffected by these distinctions since Q_j or Q^*_j, rather than q_j, is the quantity naturally calculated in the theory. However, an ambiguity remains in experimental transport analysis if the measured particle flux $\Gamma_j = n_j V_j$ is to be used in the energy equation. This is because we cannot be sure how properly to treat the source terms $p_j \nabla \cdot V_j$ or $\{\tilde{p}_j \nabla \cdot \tilde{V}_j\}$. 17 refs.

15880 (DOE/ER/53266–31) **Dispersion relations of density fluctuations observed by heavy ion beam probe in the TEXT tokamak.** Ross, D.W. (Texas Univ., Austin, TX (USA). Fusion Research Center); Schoch, P.M.; Heard, J.W.; Crowley, T.P.; Hickok, R.L. Texas Univ., Austin, TX (USA). Fusion Research Center. Sep 1990. 36p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-88ER53266 ;FG05-88ER53267. (FRCR–358). Order Number DE91010422. Source: OSTI; NTIS; INIS; GPO Dep.

Wave numbers as functions of frequency for density fluctuations in the core of the TEXT tokamak are measured in Heavy Ion Beam Probe experiments by analyzing the relative phases of signals originating from nearby points in the plasma. The adjacent points are typically 2 cm apart, with their relative orientation (δr, $\delta\theta$) depending on position (r,θ). for angular frequencies $\omega \leq 10^6$/s the signals are quite coherent, leading to reasonably well-defined "dispersion relations." These do not correspond to known modes of the drift wave type, i.e., ballooning or slab-like electron drift waves or ion temperature gradient modes. The effect of finite sample volume size does not significantly alter this conclusion. 25 refs., 6 figs., 3 tabs.

15881 (DOE/ER/53266–35) **Effect of beam-attenuation modulation on fluctuation measurements by heavy-ion beam probe.** Ross, D.W. (Texas Univ., Austin, TX (USA). Fusion Research Center); Sloan, M.L.; Wootton, A.J.; Schoch, P.M.; Heard, J.W.; Crowley, T.P. Hickok, R.L.; Simcic, V. Texas Univ., Austin, TX (USA). Fusion Research Center. Mar 1991. 33p. Sponsored by USDOE, Washington, DC (USA); Texas Atomic Energy Research Foundation, Dallas, TX (USA). DOE Contract FG05-88ER53266 ;FG05-88ER53267. (FRCR–380). Order Number DE91010423. Source: OSTI; NTIS; INIS; GPO Dep.

Beam-attenuation modulation arising from density fluctuations along the orbit of the heavy-ion beam probe can distort the local amplitude, coherence, and phase derived from one- and two-point correlation measurements. Path-integral expressions for these effects are derived and applications to TEXT data are discussed. The effects depend critically on the ratio of the average fluctuation amplitude, $\tilde{n}_e$, along the beam path to the local $\tilde{n}_e$ at the sample volume. Because the fluctuation amplitude is small in the core and rises sharply toward the plasma edge, the contamination effect is negligible in a radial zone near the edge but rises sharply to the interior of a critical radius. With increasing average plasma density, $\tilde{n}_e$, the interior contamination increases strongly and the critical radius moves outward. 16 refs., 12 figs.

15882 (DOE/ER/53266–36) **Comparison of drift wave models with fluctuation data from the interior of the TEXT tokamak.** Ross, D.W. (Texas Univ., Austin, TX (USA). Fusion Research Center); Bravenec, R.V.; Ritz, C.P.; Sloan, M.L.; Thompson, J.R.; Wootton, A.J.; Schoch, P.M.; Heard, J.W.; Crowley, T.P.; Hickok, R.L.; Simcic, V.; Brower, D.L.; Peebles, W.A.; Luhmann, N.C. Jr. Texas Univ., Austin, TX (USA). Fusion Research Center; California

Univ., Los Angeles, CA (USA). Dec 1990. 30p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-88ER53266 ;FG05-88ER53267 ;FG03-86ER53225. (FRCR–381). Order Number DE91010424. Source: OSTI; NTIS; INIS; GPO Dep.

Experimental evidence for and against drift waves as the origin of the observed fluctuations and anomalous transport in the plasma interior is reviewed. Fluctuation spectra observed by far-infrared scattering and a heavy ion beam probe (HIBP) are compared. The FIR system observes broad $S(k,\omega)$, which are spatially resolved at large k and readily identified with electron drift waves. At higher densities a clear feature, which may be associated with ion temperature gradient modes, appears as well. A quasi-coherent feature in the drift wave range of phase velocities is also found at the inner mid-plane. But interior HIBP measurements using a thallium beam have, by a two-point correlation method, measured wave numbers far too small to be those of drift waves of either variety. Some recent measurements with a cesium beam have produced phase velocities more closely in accord with drift waves at low frequencies. It is suggested that a new mode may be present, which is not drift waves at low frequencies. It is suggested that a new mode may be present, which is not drift wave-like. However, the phase velocity and coherence of the HIBP data exhibit qualitative features that suggest possible instrumental effects. Several of these are investigated, which individually do not appear to reconcile the data with a pure drift wave model. They are sample volume size, common mode effects such as cross talk or path integrals of beam attenuation, and two-stream instabilities. Reconciliation of these measurements is important to transport studies. That is, calculated particle and energy fluxes depend sensitively on the frequency and wave number spectrum employed. The theoretical considerations about two-point correlations and possible instrumental effects are also relevant to other diagnostics using this technique.

15883 (DOE/ER/53298–2) **[Magnetofluid transport]: Progress report.** Dartmouth Coll., Hanover, NH (USA). 1991. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-89ER53298. Order Number DE91010261. Source: OSTI; NTIS; INIS; GPO Dep.

The goal of this activity is to understand the limiting factors in the containment and heating of a toroidally confined magnetofluid, seen as a model for a tokamak plasma, or to a lesser extent, for a toroidal pinch. Three main pieces of progress are: detailed predictions for realistic plasma numbers, of the helical, convective states to be expected in tokamaks driven at currents above the thresholds for the instability of the zero-flow axisymmetric profile with spatially uniform transport coefficients; numerical study of tokamak equilibrium with Braginskii transport coefficients and an energy equation; and determination of the characteristics of helically-deformed, convection-cell, plasma states by numerical methods.

15884 (DOE/ER/53300–1) **Theory of incremental turbulent transport in tokamaks: Progress report.** Similon, P.L. Yale Univ., New Haven, CT (USA). 15 Jul 1991. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-89ER53300. Order Number DE91010264. Source: OSTI; NTIS; INIS; GPO Dep.

The goal of this research is to understand how the various aspect of turbulent transport operate in tokamaks, in the presence of low frequency fluctuations such as drift waves or trapped electron modes.

15885 (DOE/ER/54109–T1) **Experimental and theoretical research in applied plasma physics: Technical progress report.** Porkolab, M. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. [1991]. 126p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-91ER54109. Order Number DE91010657. Source: OSTI; NTIS; INIS; GPO Dep.

This report contains papers on the following topics: fusion theory and computations; theory of thermonuclear plasmas; user service center; high poloidal beta studies on PBX-M; fast ECE fluctuation diagnostic for ballooning mode studies; x-ray imaging diagnostic; millimeter/submillimeter-wave fusion ion diagnostics; small scale turbulence and nonlinear dynamics in plasmas – continuation proposal; plasma turbulence and transport; and phase contrast interferometer diagnostic for long wavelength fluctuations in DIII-D.

15886 (DOE/ET/51013–291) **Axisymmetric control in tokamaks.** Humphreys, D.A. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. Feb 1991. 256p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-78ET51013. (PFC/RR–91-4). Order Number DE91009794. Source: OSTI; NTIS; INIS; GPO Dep.

Vertically elongated tokamak plasmas are intrinsically susceptible to vertical axisymmetric instabilities as a result of the quadrupole field which must be applied to produce the elongation. The present work analyzes the axisymmetric control necessary to stabilize elongated equilibria, with special application to the Alcator C-MOD tokamak. A rigid current-conserving filamentary plasma model is applied to Alcator C-MOD stability analysis, and limitations of the model are addressed. A more physically accurate nonrigid plasma model is developed using a perturbed equilibrium approach to estimate linearized plasma response to conductor current variations. This model includes novel flux conservation and vacuum vessel stabilization effects. It is found that the nonrigid model predicts significantly higher growth rates than predicted by the rigid model applied to the same equilibria. The nonrigid model is then applied to active control system design. Multivariable pole placement techniques are used to determine performance optimized control laws. Formalisms are developed for implementing and improving nominal feedback laws using the C-MOD digital-analog hybrid control system architecture. A proportional-derivative output observer which does not require solution of the nonlinear Ricatti equation is developed to help accomplish this implementation. The nonrigid flux conserving perturbed equilibrium plasma model indicates that equilibria with separatrix elongation of at least $\kappa_{sep} = 1.85$ can be stabilized robustly with the present control architecture and conductor/sensor configuration.

15887 (DOE/ET/53088–481) **On broken ballooning symmetry.** Zhang, Y.Z.; Mahajan, S.M. Texas Univ., Austin, TX (USA). Inst. for Fusion Studies. Mar 1991. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG05-80ET53088. (IFSR–481). Order Number DE91010878. Source: OSTI; NTIS; INIS; GPO Dep.

A 2-D ballooning transform is devised to investigate ballooning symmetry breaking effects. It is found that there are stringent limitations on the use of 1-D eigenmode equations to describe plasma stability. 2 refs., 1 fig.

15888 (GA-A–20362) **Applied plasma physics: Annual report, October 1, 1989–September 30, 1990.** General Atomics, San Diego, CA (USA). Mar 1991. 55p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-89ER53277. Order Number DE91010696. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses research in the following areas: applied plasma physics overview; fusion plasma theory; fusion user service center; and diagnostics.

15889 (GA-A–20363) **Fusion technology development: Annual report, October 1, 1989–September 30, 1990.** General Atomics, San Diego, CA (USA). Mar 1991. 30p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-89ER52153. Order Number DE91010697. Source: OSTI; NTIS; INIS; GPO Dep.

This report discusses development and technology overview of plasma technologies and fusion technologies. In particular, this report discusses research on: RF technologies; plasma facing components; reactor design studies; and fusion nuclear technology.

15890 (GA-C–20285) **An edge density fluctuation diagnostic for DIII-D using lithium beams: Technical progress report, [March 15, 1990–August 15, 1990].** Thomas, D.M. General Atomics, San Diego, CA (USA). Oct 1990. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG03-90ER54081. Order Number DE91009814. Source: OSTI; NTIS; INIS; GPO Dep.

This report covers the research conducted under US Department of Energy Grant No. DE-FG02-90ER54081 during the period 3/15/90 through 8/15/90. Highlights include the procurement of the highly stabilized beam energy power supply, and the acquisition of relevant high speed lithium fluorescence data from the edge region of both limiter (TEXT) and divertor (ASDEX) tokamak plasmas. We have also presented a paper at the Hyannis Plasma Diagnostics Conference (to be published in Review of Scientific Instruments)

which covers the planned diagnostic system. The work on this project may be naturally organized according to the following six sub-areas: Ion source/beam system, neutralizer system, optical system, data acquisition, data analysis, and machine (DIII-D) interface. Progress in each of these areas will be discussed briefly.

15891 (INIS-mf–12798) **Electron density fluctuation measurements in the TORTUR tokamak.** Remkes, G.J.J. Rijksuniversiteit Utrecht (Netherlands). 6 Jun 1990 155p. Order Number DE91623712. Source: OSTI; NTIS (US Sales Only); INIS.

Includes summary and introduction in Dutch.

This thesis deals with measurements of electron-density fluctuations in the TORTUR tokamak. These measurements are carried out by making use of collective scattering of electromagnetic beams. The choice of the wavelength of the probing beam used in collective scattering experiments has important consequences. in this thesis it is argued that the best choice for a wavelength lies in the region 0.1–1 mm. Because sources in this region were not disposable a 2 mm collective scattering apparatus has been used as a fair compromise. The scattering theory, somewhat adapted to the specific TORTUR situation, is discussed in Ch. 2. Large scattering angles are admitted in scattering experiments with 2 mm probing beams. This had consequences for the spatial response functions. Special attention has been paid to the wave number resolution. Expressions for the minimum source power have been determined for two detection techniques. The design and implementation of the scattering apparatus has been described in Ch. 3. The available location of the scattering volume and values of the scattering angle have been determined. The effect of beam deflection due to refraction effects is evaluated. The electronic system is introduced. Ch. 4 presents the results of measurements of density fluctuations in the TORTUR tokamak in the frequency range 1 kHz to 100 MHz end the wave number region 400–4000 m^{-1} in different regions of the plasma. Correlation between density and magnetic fluctuations has been found in a number of cases. During the current decay at the termination of several plasma discharges minor disruptions occurred. The fluctuations during these disruptions have been monitored. Measurements have been performed in hydrogen as well as deuterium. A possible dependence of the wave number on the ion gyroradius has been investigated. The isotropy of the fluctuations in the poloidal plane was investigated. A theoretical discussion of the measured results is given in ch. 5.

15892 (INIS-SU–238/A) **Plasma physics: Collection.** Kratkie soobshcheniya po fizike. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989 56p. (In Russian). Order Number DE91003082. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers in this collection are indexed.

15893 (INIS-SU–240, pp. 3-17) **Start-up of the T-15 tokamak.** Al'khimovich, V.A. (and others); Akhtyrskij, S.V.; Babaev, I.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 75p. (In Russian). In *Thermonuclear synthesis: Scientific-technical collection.* Order Number DE91003079. Source: OSTI; NTIS (US Sales Only); INIS.

Consideration is given to main results of performing start-up of the T-15 tokamak: arrangement and tests of electromagnetic system; cryostat pumping-out to 10^{-5} Tor and discharge chamber - to 10^{-6} Tor; cooling of cryoresistive objects down to 80-100K and superconducting winding of toroidal field (SWTF)-down to 10-20K; attainment of superconducting SWTF state; break-down and plasma production with ≈ 120kA currents, ≈ $3x10^{-18}m^3$ concentration and ≈ 0.1S duration. 9 refs.; 10 figs.; 3 tabs.

15894 (INIS-SU–240, pp. 40-45) **Stable pinches for controlled fusion.** Chernov, A.A. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 75p. (In Russian). In *Thermonuclear synthesis: Scientific-technical collection.* Order Number DE91003079. Source: OSTI; NTIS (US Sales Only); INIS.

Consideration is given to some physical aspects of using 'stable' pinch for controlled fusion and as the neutron source. The approximate life-time of such pinch is equal to 100 MHD-times and is determined by development of m=1 helical mode or by small-scale instabilities of transverse current, leading to abnormal energy release for pinch lifetime. It is shown that neutron yield depends mainly on stabilizing mechanism and is maximal at optimally chosen initial pinch parameters. Existence of 'stable' pinch during 100 MHD-times enables to consider plants of plasma focus type as a powerfull neutron source. 28 refs., 1 fig.

15895 (INIS-SU–240, pp. 58-59) **Target plasma source with a gap shape of the discharge channel for the AMBAL-Yu device.** Dimov, G.I.; Kaabantsev, A.A.; Taskaev, S.Yu. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 75p. (In Russian). In *Thermonuclear synthesis: Scientific-technical collection.* Order Number DE91003079. Source: OSTI; NTIS (US Sales Only); INIS.

Plasma source with a gap shape of discharge channel has been developed to improve parameters of target plasma in the open AMBAL-Yu magnetic gap. Dimensions of plasma jet in initial cross section - 24x126mm along the axes, peak density - up to $10^{15}cm^{-3}$ temperature - 10-20 eV. Increase of magnetic field in the source enabled to decrease β several times in plasma jet as compared to jets of ring plasma guns. This produced a positive effect on its stability with respect to bulb disturbances in the regions of transporting field with unfavourable curvature. This enabled to improve sufficiently the target plasma parameters in the middle plane of AMBAL-Yu trap along with closer location of gap plasma gun to magnetic plug. 3 refs.; 3 figs.

15896 (INIS-SU–240, pp. 27-36) **Some problems of plasma diagnostics for experimental fusion reactor.** Orlinskij, D.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 75p. (In Russian). In *Thermonuclear synthesis: Scientific-technical collection.* Order Number DE91003079. Source: OSTI; NTIS (US Sales Only); INIS.

Main difficulties which occur when designing diagnostic complex of experimental tokamak reactor are considered. The complex is disignated for performing the cycle of physical plasma investigations with sufficient α-particle contribution to energy balance, as well as for application as transducers of reactor control sustem at production stage of its operation. 26 refs.; 6 figs.; 2 tabs.

15897 (INIS-SU–240, pp. 37-39) **Nuclear-physics diagnostics of ion temperature in hot deuterium plasma.** Kamal', M.; Kukulin, V.I.; Voronchev, V.T. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 75p. (In Russian). In *Thermonuclear synthesis: Scientific-technical collection.* Order Number DE91003079. Source: OSTI; NTIS (US Sales Only); INIS.

Nuclear-physical method for determining ion temperature of hot deuterium-containing plasma is suggested. The method is based on ^6Li ion addition into deuterium plasma and corresponding measurements of γ-quanti yield in the following reactions: $^6Li(d,n)^7Be^* \rightarrow Be+\gamma$ (E_γ=431 keV) and $^6Li(d,p)^7Li^* \rightarrow ^7Li+\gamma$($E_\gamma$=478 keV). The extrapolation procedure was used to calculate cross-sections of mentioned reactions at E<100 keV and to determine low-temperature rates of $<\sigma>$ reactions. The obtained data enabled to evaluate the yield of monochromatic γ-quanti in plants with magnetic plasma containment. Principle possibility of determining (or evaluating) function of ion distribution with respect to rates was considered. 14 refs.; 1 fig.; 2 tabs.

15898 (INIS-SU–240, pp. 65-68) **Influence of motion nonadiabaticity on particle kinetics in cusped magnetic trap.** Poletaev, D.L. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 75p. (In Russian). In *Thermonuclear synthesis: Scientific-technical collection.* Order Number DE91003079. Source: OSTI; NTIS (US Sales Only); INIS.

Detailed numerical simulation of motion of charged particle ensemble in the model field of axisymmetric casp was conducted. Effect of motion nonadiabaticity on ensemble parameters was investigated. It is shown that particle diffusion with respect to pitch-angle in velocity space can be described analytically in the region of weak nonadiabaticity. Boundaries of the region of strong nonadiabaticity, where particle ensemble becomes isotropic, and particle containment is determined by gas-dynamic flow through casp plugs, were established. Statement of the problem of plasma kinetics in casped magnetic trap was considered on the basis of such analysis. 9 refs.; 3 figs.

15899 (INIS-SU-240, pp. 69-72) **Electron transverse transport in a multigap electromagnetic trap with axisymmetric magnetic field.** Germanova, S.V.; Lavrent'ev, O.A.; Petrenko, V.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 75p. (In Russian). In *Thermonuclear synthesis: Scientific-technical collection.* Order Number DE91003079. Source: OSTI; NTIS (US Sales Only); INIS.

Calculation of electron transverse transport in multigap electron trap of axisymmetric magnetic field has been performed. The equations of classical diffusion and electron mobility were used. This calculation has been made by computational methods for a real structure of 'Yupiter-2M' experimental device magnetic fields. 8 refs.; 5 figs.

15900 (INIS-SU-240, pp. 60-64) **Plasma oscillations and their influence on the ion beam dynamics in the injector of a thermonuclear reactor.** Sidorov, V.P.; Udovichenko, S.Yu. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 75p. (In Russian). In *Thermonuclear synthesis: Scientific-technical collection.* Order Number DE91003079. Source: OSTI; NTIS (US Sales Only); INIS.

Low-frequency volume plasma oscillations, excited by negative ion beam and deteriorating its transport through the neutralizer gas medium in the injector of thermonuclear reactor, were investigated. It is concluded that, negative ion beam is more active source of excitation of plasma oscillations which can deteriorate its transport through the gas neutralizer medium in the injector of thermonuclear reactor. Excitation of high-frequency surface oscillations in plasma, diffusing in a proper ambipolar electric field through the ion beam boundary, is considered. It is shown that Miller force, occurring in result of particle motion averaging in rapidly oscillating field of surface oscillations, will affect firstly the electrons; deviation of positive plasma ions to the periphery and fast negative ions - to injector axis will take place. 12 refs.

15901 (INIS-SU-241, pp. 65-71) **Ray refraction in a fully-ionized axisymmetrical plasma.** Abzaev, F.M. Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1988. 86p. (In Russian). In *Techniques and computer codes for numerical solution of mathematical physics problems: Scientific-technical collection.* Order Number DE91003080. Source: OSTI; NTIS (US Sales Only); INIS.

Analytical and numerical methods are used to obtain the approximate formulas for ray refraction angle when passing through plasma with exponential dip of density profile. In the region of small values of the refraction angle its dependence on electron density in the point of ray turn is described by exponential function with index, close to one, and the value is inversely proportional to the square of frequency of incident radiation. 6 refs.; 5 figs.; 2 tabs.

15902 (IPF-89-1) **Numerical calculation of the voltage profile and the bias-voltages in plasma reactors with HF-discharges.** Deutsch, R.; Erz, U.; Herold, H.; Raeuchle, E. Stuttgart Univ. (Germany, F.R.). Inst. fuer Plasmaforschung. Apr 1989. 61p. (In German). Order Number DE91764560. Source: OSTI; NTIS (US Sales Only); INIS.

Investigation of plasma-wall interaction is important, since the boundary layer fields determine the ion energy and thus the processes of deposition or sputtering. Electric currents between plasma and wall cause strong fields in the boundary layer, which accelerate relative slow ions and generate sputtering processes. The authors derive from the microscopical boundary-layer theory the current-voltage characteristic of the boundary layer and the capacity as an analytical function of the layer voltage and solve a system of nonlinear differential equations, describing the current-voltage relations in the whole circuit and also the fields in the boundary layer. The numerical solution of these equations is the goal of this publication. Starting from the traditional Langumir theory the system of differential equations is formulated for a plasma reactor model and solved for different external voltage signals. Nonlinear oscillations of voltage and current occur in the system. Resonance processes are important for the intensity of the produced fields. The currents and voltages at the two boundary layers are coupled to each other and to the capacitive, resistive and inductive elements and together determine the dependence of the fields on external parameters (i.e. electrode cross sections, signal frequency, signal amplitude etc.). The used theory does not take care of stationary magnetic fields which may be present. (AH).

15903 (IPP-1/254) **Investigation of magnetic modes in the ASDEX tokamak.** Zohm, H. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Heidelberg Univ. (Germany, F.R.). Fakultaet fuer Physik und Astronomie. Oct 1990. 110p. (In German). Order Number DE91764558. Source: OSTI; NTIS (US Sales Only); INIS.

Properties of MHD-modes in the ASDEX Tokamak have been investigated by application and further development of the MIRNOV-diagnostics, i.e. measurement of magnetic field fluctuations. In addition to evaluation methods supported by models, also a model-independent statistical data analysis makes sense. The very important physics of mode locking, i.e. the slowing-down of rotating modes is examined. An elaborated theoretical model allows an interpretation of experimental results. Especially interesting is the loss of the angular momentum of rotating plasmas by mode locking. Experiments for mode stabilisation and prevention of electric current breakdown are discussed. Additional MHD-processes under different plasma conditions are treated on the fundament of the devloped model ideas. The author shows that the main tokamak plasma is described very well by one-dimensional models with cylindrical geometry, while the boundary zone of the plasma demands a more complex analysis. In the appendix a concept for the investigation of the MHD-activity in ASDEX-Upgrade is discussed. (AH).

15904 (IPP-5/33) **Evolution of high-density particle clouds in magnetically confined plasmas.** Zavala Guzman, G. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Michigan Univ., Ann Arbor, MI (USA). Dept. of Nuclear Engineering. Dec 1989. 65p. Order Number DE91764701. Source: OSTI; NTIS (US Sales Only); INIS.

The subject of this study is the spatial and time evolution of initially low-temperature high-density particle clouds in magnetically confined hot plasmas, such as those produced by ablating cryogenic hydrogen pellets in fusion machines. Particular attention is given to such physical processes as heating of the cloud by the energy fluxes carried by incident plasma particles (classical flux-limited energy transport by thermal electrons along the magnetic field lines, anomalous heat conduction across them), gasdynamic expansion with j vectorxB vector-produced deceleration in the transverse direction, finite-rate ionization and recombination (collisional and radiative) processes, and magnetic field convection and diffusion. The Lagrangian approximation used allows one to take into account all relevant physical processes that affect the radial expansion and deceleration of the cloud particles, including the change of the magnetic field topology. The results show the existence of a distinct structure in the ablatant cloud surrounding an ablating pellet: A hollow temperature profile coupled to a peaked density profile in the plane normal to the magnetic field direction. The lifetime of this structure is measured on hydrodynamic time scales. The basic properties of the cloud, such as its radial extent, average temperature, bulk density, etc., are complex functions of the pellet ablation rate, the parameters of the background plasma, and the magnetic field strength applied. Simple analytical or ad hoc description of this functionality, as done in present ablation models, does not seem to be possible. (orig.).

15905 (IPP-III/160) **Investigation of transport-relevant fluctuations in the plasma boundary of ASDEX.** Rudyj, A. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik. Jul 1990. 124p. (In German). Order Number DE91764559. Source: OSTI; NTIS (US Sales Only); INIS.

After the discussion of plasma diagnostics the local radial particle flux in the plasma edge is described, followed by a treatment of the density and potential fluctuations in the boundary zone. A statistical analysis determines the correlation lengths of the observed fluctuations in directions poloidal, radial and parallel to the magnetic field. Power density spectra and coherent spectra lead to

better understanding of the fluctuations. The asymmetry of the fluctuation amplitude between high and low field side of the torus has been observed in a tokamak for the first time. Furtheron the dependence of the fluctuation properties on global plasma parameters is examined, together with the extremely high flucutations' correlation along the magnetic field lines. The response of the fluctuations to additional heating by neutral beam injection is elaborated, especially in the H-mode of better plasma confinement. ASDEX fluctuations are compared with such of other machines, followed by a survey of the manifold instabilities and their properties. The appendix discusses the divertor tokamak ASDEX and the applied statistical methods. (AH).

15906 (ITEF–171-89) **Ionization recombination and emissivity coefficients of optically thin dense plasma.** Gerusov, A.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Teoreticheskoj i Ehksperimental'noj Fiziki. 1989. 32p. (In Russian). Order Number DE91623725. Source: OSTI; NTIS (US Sales Only); INIS.

The simple approximate method for calculation of ionization equilibrium and emissivity of optically thin dense plasma consisting from ions with K, L, M, N atomic shells is considered. The structure of energy levels has chosen in the following manner: all levels with $\Delta n=0$ is grouped in basic state and levels with $\Delta n>=1$ is described in hydrogen like approximation. The equation system for levels populations includes collisional ionization and three-body recombination, collisional excitation and deexcitation radiative and dielectronic recombination, radiative spontaneous decay. Ionization and recombination coefficients of plasma are derived in quasisteady state approximation. Numerical analysis of ionization, recombination and emissivity coefficients for Cu in range 40 eV $\leq T_e \leq$ 40 keV, $10^{16} \leq Ne \leq 10^{24} cm^{-3}$ is carried out. 12 refs.; 8 figs.

15907 (JET-R–90-05) **Feasibility study of bulk ion temperature measurements on JET by means of collective scattering of gyrotron radiation.** Orsitto, F. (ENEA, Frascati (Italy). Centro Ricerche Energia). Commission of the European Communities, Abingdon (UK). JET Joint Undertaking. Oct 1990. 42p. Contract JE8/9011. Order Number DE91623716. Source: OSTI; NTIS (US Sales Only); INIS.

In the proposal for a Thomson scattering diagnostic for fast ions and alpha particles in the JET tokamak, using a gyrotron (λ_o=0.214 cm), the possibility of measuring the plasma ion temperature was considered in general. In this report we discuss the possibility of measuring the bulk ion feature in detail, because the proposed diagnostic could give detailed information on the ion dynamics through the measurement of the spatial ion temperature profile, possibly resolved in time. (author).

15908 (KFTI–89-3) **Collective interaction of monoenergetic relativistic high-energy electron beams with plasma.** Berezin, A.K.; Kiselev, V.A.; Onishchenko, I.N.; Fajnberg, Ya.B. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1989. 16p. (In Russian). Order Number DE91623756. Source: OSTI; NTIS (US Sales Only); INIS.

Results of experimental and theoretical investigations of interactions of modulated relativistic electron beams (REB) with plasma and monoenergetic REB with dense plasma are presented. Coherent energy losses of modulated relativistic beam and excitation of collective oscillations in plasma by the beam conditioned by Vavilov-Cherenkov effect are revealed. It is shown that efficiency of interaction of monoenergetic REB with low angular divergence with plasma doesn't decrease as plasma density grows. 27 refs.; 8 figs.

15909 (KFTI–89-9) **Numerical solution of dispersion equation for two-stream ion-ion instability.** D'yakov, V.E.; Ol'shanskij, V.V.; Panchenko, V.I. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1989. 6p. (In Russian). Order Number DE91623738. Source: OSTI; NTIS (US Sales Only); INIS.

Algorithm for numerical solution of nonlinear transcendental dispersion equation used for study of potential oscillations in homogenous plasma is described. The description of program realization of this algorithm for the BESM-6 computer is presented. 4 refs.; 1 fig.

15910 (KFTI–89-10) **Numerical analysis of dispersion equation for electrostatic oscillations of ion-ion plasma in strong magnetic field: Part 2.** D'yakov, V.E.; Ol'shanskij, V.V.; Panchenko, V.I. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst. 1989. 10p. (In Russian). Order Number DE91623737. Source: OSTI; NTIS (US Sales Only); INIS.

Consideration is given to results of numerical investigation of the linear stage of ion-ion instability of plasma located in strong homogeneous and stationary magnetic field conditioned by relative movement of ion components transverse to magnetic field. Dependences of critical relative velocity of ion components increment of oscillation, growth and dimensions of instability region in wave number space in wide ranges of changes of parameters, namely the ratios of temperatures for two types of ions T_{01}/T_{02} and their concentrations n_1/n_2 are presented (T_{01}/T_{02}=0.1-10, n_1/n_2=0.1-10). 5 refs.; 8 figs.

15911 (ORNL/TM–11545) **ATF edge plasma turbulence studies using a fast reciprocating Langmuir probe.** Uckan, T. (Oak Ridge National Lab., TN (USA)); Hidalgo, C.; Bell, J.D.; Harris, J.H.; Dunlap, J.L.; Dyer, G.R.; Mioduszewski, P.K.; Wilgen, J.B.; Ritz, C.P.; Wootton, A.J.; Rhodes, T.L.; Carter, K. Oak Ridge National Lab., TN (USA). Jan 1991. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010487. Source: OSTI; NTIS; INIS; GPO Dep.

Electrostatic turbulence on the edge of the Advanced Toroidal Facility (ATF) torsatron is investigated experimentally with a fast reciprocating Langmuir probe (FRLP) array. Initial measurements of plasma electron density n_e and temperature T_e and fluctuations in density ($\tilde{n}_e$) and plasma floating potential ($\tilde{\phi}_f$) are made in electron cyclotron heated plasmas at 1 T. At the last closed flux surface (LCFS, $r_{\surd}/a \sim 1$), $T_e \approx$ 20–40 eV and $n_e \approx 10^{12}$ cm^{-3} for a line-averaged electron density $\bar{n}_e$ = (3–6) x 10^{12} cm^{-3}. Relative fluctuation levels, as the FRLP is moved into core plasma where $T_e >$ 20 eV, are $\tilde{n}_e/n_e \approx$ 5% and $e\tilde{\phi}_f/T_e \approx 2\tilde{n}_e/n_e$ about 2 cm inside the LCFS. The observed fluctuation spectra are broadband (40–300 kHz) with $\bar{k}\rho_s \leq 0.1$, where $\bar{k}$ is the wavenumber of the fluctuations and ρ_s is the ion Larmor radius at the sound speed. The propagation direction of the fluctuations reverses to the electron diamagnetic direction around $r_{\surd}/a < 1$. The phase velocity and the electron drift velocity are comparable ($v_{ph} \sim v_{de}$). The fluctuation-induced particle flux is comparable to fluxes estimated from the particle balance using the H_α spectroscopic measurements. Many of the features seen in these experiments resemble the features of ohmically heated plasmas in the Texas Experimental Tokamak (TEXT). 18 refs., 10 figs.

15912 (ORNL/TM–11701) **Mercier stability and transport properties of the URAGAN-2M and ATF torsatrons.** Dominguez, N. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA). Computing and Telecommunications Div.); Carreras, B.A.; Lynch, V.E.; Tolliver, J.S.; Bykov, V.E.; Grekov, D.L.; Shishkin, A.A. Oak Ridge National Lab., TN (USA). Feb 1991. 30p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010488. Source: OSTI; NTIS; INIS; GPO Dep.

The equilibrium, Mercier stability, and neoclassical transport (in the $1/\nu$ regime) properties of two $\ell = 2$ torsatrons, the Advanced Toroidal Facility (ATF) and URAGAN-2M, are compared. ATF and URAGAN-2M have 12 and 4 field periods, respectively. The two torsatrons have similar arrays of coils. Dipole and quadrupole magnetic fields can be used to improve transport at zero beta, but increasing beta tends to undo the optimization. 18 refs., 19 figs., 2 tabs.

15913 (ORNL/TM–11756) **Transport analysis of stellarator reactors.** Painter, S.L. (Tennessee Univ., Knoxville, TN (USA). Dept. of Nuclear Engineering); Lyon, J.F. Oak Ridge National Lab., TN (USA). Feb 1991. 47p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010489. Source: OSTI; NTIS; INIS; GPO Dep.

The performance of deuterium-tritium stellarator reactors is studied with a new, fast one-dimensional (1-D) transport survey code that is based on the spectral collocation method. Two operating modes with different signs of the assumed radial electric field are

identified. The operating mode with a positive electric field is characterized by high temperatures and moderate densities, whereas the other mode has lower temperatures and higher densities. Both modes lead to possible reactors that could tolerate a large alpha-particle energy loss. The sensitivity to device parameters and to profile assumptions is examined. Scaling expressions useful for parametric studies are obtained for different quantities of interest, and the 1-D code results are compared with results derived from an empirical scaling relation. Deuterium-helium-3 (D-^{3}He) operation is also feasible but is more demanding. The implications for stellarator reactor design optimization are discussed. 47 refs., 16 figs., 1 tab.

15914 (ORNL/TM–11758) **Inversion of chordal data from the ATF torsatron.** Baylor, L.R.; Ma, C.H.; Hiroe, S. Oak Ridge National Lab., TN (USA). Feb 1991. 21p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010490. Source: OSTI; NTIS; INIS; GPO Dep.

A method to obtain electron density profiles from chordal interferometric measurements of a tokamak plasma has been extended to the non-axisymmetric stellarator geometry of the Advanced Toroidal Facility (ATF) torsatron. The method requires a known magnetic flux surface geometry expressed in spectral form. The method has been applied to both interferometer density data and bolometer irradiance data from ATF, and results are presented. The resulting inverted density profiles are integrated along a horizontal path and compare favorably with line integral measurements of the density. Sensitivities of the resulting profiles to variations in the flux surface geometry and errors in the measurements are discussed.

15915 (OUP–90-33) **Electron collision frequency in microwave exposed plasma.** Mentzoni, M. Oslo Univ. (Norway). Fysisk Inst. Dec 1990. 19p. Order Number DE91623717. Source: OSTI; NTIS (US Sales Only); INIS.

In many situations of electromagnetic wave propagation through plasma, the problem of nonlinearity arises. This is particularly important in the context of microwave diagnostics, which in many cases aims at measuring the characteristics of an undisturbed plasma. The present paper deals analytically with the problem on nonlinearity, particularly from the point of view of microwave plasma diagnostics. 3 refs., 6 figs.

15916 (PPPL–2736) **Effect of surface modes on coupling to fast waves in the LHRF.** Pinsker, R.I.; Colestock, P.L. Princeton Univ., NJ (USA). Plasma Physics Lab. 16 Sep 1990. 37p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03073. Order Number DE91010042. Source: OSTI; NTIS; INIS; GPO Dep.

The effect of surface modes of propagation on coupling to fast waves in the LHRF is studied theoretically and experimentally. The previously reported 'up-down' poloidal phasing asymmetry for coupling to a uniform plasma is shown to be due to the properties of a mode which carries energy along the plasma-conducting wall interface. Comparison of the theory with coupling experiments performed on the PLT tokamak with a phased array of twelve dielectric-loaded waveguides at 800 MHz shows that the observed dependence of the net reflection coefficient on toroidal phase angle can be explained only if the surface wave is taken into account. 43 refs., 10 figs.

15917 (PPPL–2737) **The computation of resistive MHD instabilities in axisymmetric toroidal plasmas.** Harley, T.R.; Cheng, C.Z.; Jardin, S.C. Princeton Univ., NJ (USA). Plasma Physics Lab. Mar 1991. 66p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03073. Order Number DE91010725. Source: OSTI; NTIS; INIS; GPO Dep.

We describe the linear MHD eigenmode code NOVA-R, which calculates the resistive stability of axisymmetric toroidal equilibria. A formulation has been adopted which accurately resolves the continuum spectrum of the ideal MHD operator. The resistive MHD stability equations are transformed into three coupled second order equations, one of which recovers the equation solved by the NOVA code in the ideal limit. The eigenfunctions are represented by a Fourier expansion and cubic B-spline finite elements which are packed about the internal boundary layer. Accurate results are presented for dimensionless resistivities as low as 10^{-30} in cylindrical geometry. For axisymmetric toroidal plasmas we demonstrate the accuracy of the NOVA-R code by recovering ideal results in the $\eta \rightarrow 0$ limit, and cylindrical resistive interchange results in the $a/R \rightarrow$ limit. Δ' analysis performed using the eigenfunctions computed by the NOVA-R code agree with the asymptotic matching results from the resistive PEST code for zero beta equilibria. 33 refs., 30 figs.

15918 (PPPL–2738) **ICRF sawtooth stabilization: Application on TFTR and CIT.** Hosea, J.C. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Phillips, C.K.; Stevens, J.E.; Wilson, J.R.; Bell, M.; Boivin, R.; Cavallo, A.; Colestock, P.; Fredrickson, E.; Hammett, G.; Hsuan, H.; Janos, A.; Jassby, D.; Jobes, F.; McGuire, K.; Mueller, D.Princeton Univ., NJ (USA). Plasma Physics Lab. Mar 1991. 33p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03073. Order Number DE91010043. Source: OSTI; NTIS; INIS; GPO Dep.

The use of ICRF heating to stabilize the core plasma sawtooth relaxations has been extended to TFTR where such stabilization has been produced at relatively low power in the L Mode regime at moderate density (P_{RF} = 4 MW, 2.6 MW in helium and deuterium discharges, respectively, for the minority hydrogen ICRF heating regime with $\bar{n}_e \approx 2.5 \times 10^{13}$ cm^{-3}). These results, as in the case of those obtained on JET, are qualitatively consistent with energetic ion stabilization of the m = 1, n = 1 ideal/resistive kink mode. The relevance of sawtooth stabilization to the primary regimes of interest on TFTR – the high-Q supershot regime and the high density pellet injection regimes – and on CIT – the high density ICRF heated regime – is considered in the context of the present theory and the projected ICRF power deposition characteristics. 35 refs., 11 figs.

15919 (PPPL–2740) **Excitation of toroidal Alfven eigenmodes in TFTR.** Wong, K.L.; Fonck, R.J.; Paul, S.F.; Roberts, D.R.; Fredrickson, E.D.; Nazikian, R.; Park, H.K.; Strachan, J.D.; Bell, M.; Bretz, N.L.; Budny, R.; Cohen, S.; Hammett, G.W.; Jobes, F.C.; Meade, D.M.; Medley, S.S.; Mueller, D.; Nagayama, Y.; Owens, D.K.; SynPrinceton Univ., NJ (USA). Plasma Physics Lab. Mar 1991. 16p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03073. Order Number DE91011007. Source: OSTI; NTIS; INIS; GPO Dep.

Deuterium neutral beams with energies up to 110 keV were injected into TFTR (Tokamak Fusion Test Reactor) plasmas at low magnetic field such that the beam injection velocities were comparable to the Alfven velocity. Excitation of toroidal Alfven eigenmodes was observed by Mirnov coils and beam emission spectroscopy. 10 refs., 4 figs.

15920 (RAL–90-082) **Thermal effects in relativistic plasmas.** Castaldo, C. (Naples Univ. (Italy). Dept. of Physical Sciences); Fedele, R.; Angelis, U. de; Bingham, R. Rutherford Appleton Lab., Chilton (UK). Nov 1990. 9p. Order Number DE91623704. Source: OSTI; NTIS (US Sales Only); INIS.

A kinetic approach is used for a description of a plasma in the presence of a large amplitude wave (ie relativistic electrons). The case of a "small" momentum spread around an average momentum is considered and corrections to the cold plasma case (zero spread) are given. (author).

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Refer also to citation(s) 14929, 15107, 15876, 15877, 15885, 15889, 15957

15921 (ANL/CP–70627) **Tritium retention and release analysis for US-ITER blanket.** Billone, M.C.; Lin, C.C.; Attaya, H.; Gohar, Y. Argonne National Lab., IL (USA). Nov 1990. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-901007–63: 9. topical meeting on technology of fusion energy, Oak Brook, IL (USA), 7-11 Oct 1990). Order Number DE91010629. Source: OSTI; NTIS; INIS; GPO Dep.

The US design for the ITER tritium-breeding blanket consists of layers of Be multiplier, stainless steel cladding, and Li_2O ceramic breeder. Tritium is recovered from the ceramic breeder by purging it with He + 0.2% H_2. Models have been developed to describe the purge-flow thermal-hydraulics and gas reactions and the tritium retention/release due to lattice diffusion, desorption/adsorption, solubility/precipitation, and percolation through interconnected

porosity. These have been incorporated into the steady-state code TIARA for the purpose of performing design calculations for Tritium Inventory and Release Analysis. Transient calculations for pulsed operation are done with a modified version of the DISPL code. The results of both steady-state and transient analyses for tritium retention and releases are given for anticipated ITER operating conditions. 13 refs., 6 figs., 3 tabs.

15922 (CONF-890931–13) **Bounded plasma device simulation with PDW1, including: External RLC circuit, DC and RF drive, and collisional processes.** Morey, I.J.; Verboncoeur, J.P.; Vahedi, V. California Univ., Berkeley, CA (USA). Electronics Research Lab. [1989]. 4p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA). DOE Contract FG03-90ER54079 ;FG03-86ER53220. N00014-85-K-0809. From 13. conference on the numerical simulation of plasmas; Santa Fe, NM (USA); 17-20 Sep 1989. Order Number DE91009832. Source: OSTI; NTIS; INIS; GPO Dep.

Short communication. PLASMA SIMULATION/p codes; PLASMA SCRAPE-OFF LAYER/plasma simulation; COMPUTER GRAPHICS; BOUNDARY CONDITIONS; PHASE SPACE; IONIZATION; CROSS SECTIONS; COLLISIONS; RF SYSTEMS

15923 (CONF-910609–5) **The effect of realistic antenna geometries on plasma loading predictions.** Ryan, P.M.; Baity, F.W.; Batchelor, D.B.; Goulding, R.H.; Hoffman, D.J.; Tolliver, J.S. Oak Ridge National Lab., TN (USA). [1991]. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From 18. European conference on controlled fusion and plasma physics; Berlin (Germany, F.R.); 3-7 Jun 1991. Order Number DE91010782. Source: OSTI; NTIS; INIS; GPO Dep.

Plasma loading resistances for Ion Cyclotron Resonance Heating (ICRH) antennas are often calculated with sophisticated plasma models and only rudimentary antenna geometries. This paper presents techniques for modifying loading calculations for cavity antennas to account for such realities as return currents in the antenna sidewalls and backplane, the transmission and reflection properties of the Faraday shield, the end effects due to a finite length antenna, the reduction in phase velocity due to strap interaction with the Faraday shield, and the effect of slots in the cavity sidewalls and dividing septa. 4 refs., 4 figs.

15924 (DOE/DP/40200–149-Vol.45) **LLE review: Volume 45: Quarterly report, October–December 1990.** Epperlein, E.M. (ed.). Rochester Univ., NY (USA). Lab. for Laser Energetics. [1991]. 64p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FC03-85DP40200. Order Number DE91010027. Source: OSTI; NTIS; GPO Dep.

This volume of the LLE Review, covering the period October–December 1990, contains descriptions of a new phase-conversion technique designed to improve irradiation uniformity, a report on the interpretation of high-density implosion experiments of argon-filled targets, and an article on the use of absorption spectroscopy to diagnose compressed target layers. The section on advanced technology has a report on the application of KTP crystals as electro-optic amplitude modulators, and describes the use of chirped-pulsed technology to measure $X^{(3)}$ by nearly degenerate four-wave mixing. Finally, the activities of the National Laser Users Facility and the GDL and OMEGA laser facilities are summarized. The highlights of this issue are a new phase-conversion technique based on distributed polarization rotation has been developed to provide instantaneous smoothing of the intensity nonuniformities at the target plane. The one-dimensional hydrodynamic code LILAC, which includes an average-ion model, has been used to interpret the core conditions of high-density implosions of argon-filled polymer shell targets. The effect of temperature dependence of x-ray absorption features on the interpretation of target implosions has been investigated.

15925 (DOE/ER/18862–1) **Absence of molecular deuterium dissociation during room-temperature permeation into polystyrene ICF target shells.** Honig, A. (Syracuse Univ., NY (USA). Dept. of Physics); Alexander, N.; Fan, Q.; Gram, R.; Kim, H. Syracuse Univ., NY (USA). Dept. of Physics; Rochester Univ., NY (USA). Lab. for Laser Energetics. [1991]. 16p. Sponsored by USDOE, Washington, DC (USA); Empire State Electric Energy Research Corp., New York, NY (USA); New York State Energy Research and Development Authority, Albany, NY (USA); Ontario Hydro, Toronto, ON (Canada); Rochester Univ., NY (USA). DOE Contract FG03-91ER18862 ;FG03-90SF18437 ;FC03-85DP40200. Order Number DE91007120. Source: OSTI; NTIS; INIS; GPO Dep.

Polystyrene microshells filled with deuterium and tritium gas are important target shells for inertially confined fusion (ICF) and are particularly promising for target containing spin-polarized hydrogens fuels. A currently active approach to the latter uses polarized D in HD, in a method which requires preservation of the high purity of the initially prepared HD (very low specified H_2 and D_2 concentrations). This would not be possible if dissociation should occur during permeation into the target shells. We have thus tested polystyrene shells using a novel method which employs very pure polystyrene shells using a novel method which employs very pure ortho-D_2 as the test gas. An upper limit of 6×10^{-4} was deduced for the dissociation of D_2 upon room temperature permeation through an approximately 8 um wall of polystyrene, clearing the way for use of polystyrene target shells for ICF fusion experiments with spin-polarized hydrogens fuels. 19 refs., 1 fig.

15926 (DOE/ER/52161–T1) **Aqueous corrosion and stress corrosion of 316SS for the ITER water-cooled blanket concept: Progress report, 1 January 1991–1 April 1991.** Duquette, D.J.; Steiner, D. Rensselaer Polytechnic Inst., Troy, NY (USA). [1991]. 3p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-89ER52161. Order Number DE91010729. Source: OSTI; NTIS; GPO Dep.

The design of the ITER Driver blanket has been shifted from the Aqueous Lithium Salt Blanket (ALSB) concept to a design using a ceramic breeder with a beryllium multiplier. This concept utilizes water cooling with Type 316 austenitic stainless steel (316SS) as the structure. As a result, research at RPI is now being focused on corrosion and stress-corrosion behavior of 316SS in high purity water with radiolysis products present. The effects of radiolysis products on the corrosion behavior of 316SS will be monitored by in-situ potential and polarization measurements in high energy, Bremmstrahlung radiation at the Rensselaer Linear Accelerator (LINAC). Radiolysis water chemistry modeling, stress corrosion cracking, and corrosion rate calculations will be performed in the corrosion laboratory at the Rensselaer Materials Research Center.

15927 (DOE/ER/54084–1) **Impurity pellet injection experiments at TFTR: Progress report.** Marmar, E.S. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. [1991]. 4p. Sponsored by USDOE, Washington, DC (USA). DOE Contract FG02-90ER54084. Order Number DE91010263. Source: OSTI; NTIS; INIS; GPO Dep.

Impurity (Li and C) pellet experiments, which began at TFTR in 1989, and are expected to continue at least through 1991, have continued to produce new and significant results. The most significant of these are: (1) improvements in TFTR supershots after wall-conditioning by Li pellet injection; (2) accurate measurements of the pitch angle profiles of the internal magnetic field using the polarization angles of line emission from Li^+ in the pellet ablation cloud; and (3) initial measurements of pitch angle profiles using the tilt of the LI^+ emission region of the ablation cloud which is stretched out along the field lines.

15928 (DOE/ET/51013–T238) **SOLDESIGN user's manual©.** Pillsbury, R.D. Jr. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. Feb 1991. 47p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-78ET51013 ;FG02-91ER54110 ;AC22-84PC70512 ;AT01-76ET10813. (PFC/RR–91-3). Order Number DE91009795. Source: OSTI; NTIS; GPO Dep.

SOLDESIGN is a general purpose program for calculating and plotting magnetic fields, Lorentz body forces, resistances and inductances for a system of coaxial uniform current density solenoidal elements. The program was originally written in 1980 and has been evolving ever since. SOLDESIGN can be used with either interactive (terminal) or file input. Output can be to the terminal or to a file. All input is free-field with comma or space separators. SOLDESIGN contains an interactive help feature that allows the user to examine documentation while executing the program. Input to the program consists of a sequence of word

commands and numeric data. Initially, the geometry of the elements or coils is defined by specifying either the coordinates of one corner of the coil or the coil centroid, a symmetry parameter to allow certain reflections of the coil (e.g., a split pair), the radial and axial builds, and either the overall current density or the total ampere-turns (NI). A more general quadrilateral element is also available. If inductances or resistances are desired, the number of turns must be specified. Field, force, and inductance calculations also require the number of radial current sheets (or integration points). Work is underway to extend the field, force, and, possibly, inductances to non-coaxial solenoidal elements.

15929 (DOE/ET/51013–T239) **Safety and protection for large-scale magnet systems: FY90 report.** Thome, R.J.; Pillsbury, R.D. Jr.; Hale, J.R.; Mann, W.R.; Shajii, A. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. Jan 1991. 45p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-78ET51013. (PFC/RR–91-1). Order Number DE91009796. Source: OSTI; NTIS; INIS; GPO Dep.

In FY89, an Engineers/Masters thesis was completed which included a code for adiabatic quench propagation analysis in multiple, superconducting coils. The capabilities of selected stability codes for internally cooled cabled superconductors were reviewed. Zero and one-dimensional codes were selected for study and application to selected cases for initial evaluation. The modifications to the adiabatic quench code include: the ability to initiate normal regions due to temperature rise from passive materials in close proximity to portions of the superconducting winding which are remote from the initially propagating normal zone, the capability to plot temperature contours within the winding at selected instants of time, the ability to compute the local inductive voltage component within the winding so that this can be combined with the local resistive voltage to get the net voltage distribution along the conductor in the magnet. The test case to which the quench code was applied involved a superconducting solenoid with winding mandrel sections which are sufficiently conducting to carry significant induced currents during a quench and initiate normal regions at sections remote from the initially normal zone. Comparisons were made of the measured and computed current vs time profiles for the coil and with the maximum measured temperature. During FY90 we also reviewed existing codes at MIT for internally cooled cabled superconductor analysis and selected two to"exercise" for possible future modification and use in a quench propagation code. The change to quench analysis is nontrivial for this type of conductor because most codes are stability oriented and this is typically determined on a time scale of 1–10 ms, requiring substantial computational time. This report describes features of the two codes which were selected.

15930 (ECN-C–90-034) **Sensitivity and uncertainty analysis of the nuclear heating in the coils of a fusion reactor.** Hogenbirk, A. Netherlands Energy Research Foundation, Petten (Netherlands). Aug 1990. 48p. Contract ECN 1634;Contract EC NSN1, subtask 3. Order Number DE91623770. Source: OSTI; NTIS (US Sales Only); INIS.

In this report the results are presented of a study on the sensitivity of the nuclear heat in the coils of a fusion reactor to transport cross sections of the main constituents of the shielding blanket, i.e. Fe, Cr and Ni. Also the uncertainty in the above-mentioned nuclear heat due to uncertainties in these cross sections has been calculated. The effect of different cross section types was studied. Coupled (n,γ) calculations were performed using the 121-group GAM-II structure. Basic cross sections were obtained from the 217-group MAT175 library, which is based on JEF-1 and EFF-1. The one-dimensional sensitivity and uncertainty code SENSIT was used, which was modified in order to perform analyses for partial cross sections. A rather important modification of the code was made by including the gain term in the uncertainty calculations. This term was neglected in several previous investigations. The analysis was performed on a realistic iron-water NET/ITER shielding blanket, which was modelled in a one-dimensional plane geometry. S_8P_3 transport calculations were performed with the code ANISN. The resulting uncertainty, arising from uncertainties in Fe, Cr and Ni cross sections, amounts to 12.5 per cent. This figure does, however, not include the uncertainty due to uncertainties in the secondary energy and angular distributions of the neutrons (SED and SAD uncertainties). Moreover, this contribution of SED/SAD uncertainties may be substantial. The estimated upper limit of uncertainty is 20 per cent. (author). 25 refs.; 22 figs.; 8 tabs.

15931 (ECN-C–90-039) **Neutron metrology in LAMPF, USA: Experiments coded 986 and 987.** Ketema, D.J.; Nolthenius, H.J. Netherlands Energy Research Foundation, Petten (Netherlands). Aug 1990. 34p. Project 0940.01. Order Number DE91623782. Source: OSTI; NTIS (US Sales Only); INIS.

The characterization of appropriate materials for fusion reactors requires a high intensity neutron source which simulates the neutron spectrum and the radiation conditions at the positions of interest in a fusion reactor (first wall). A neutron spectrum of interest is found in the Clinton P. Anderson Los Alamos Meson Physics Facility (LAMPF). Various ceramic materials and some polycrystalline graphites were irradiated in this facility during two intervals of time in 1986 and 1987. The specimens were accompanied by several sets with activation detectors. This report presents the saturation activities per atom obtained from these sets. (author). 3 refs.; 8 figs.; 10 tabs.

15932 (ECN-I–90-040) **Neutron metrology in the HFR R139-64 (aktines): irradiation of steel as first wall material for fusion reactors.** Ketema, D.J.; Voorbraak, W.P. Netherlands Energy Research Foundation, Petten (Netherlands). Oct 1990. 49p. Order Number DE91625349. Source: OSTI; NTIS (US Sales Only); INIS.

The experiment R139-64 (Aktines) for testing the stainless steel type 316L (European reference heat) has been irradiated in the H.F.R. Petten. This report presents the final neutron metrology results obtained from activation monitors loaded in several specimen holders. Data about the helium production as well as the number of displacements per atom are also included. The report is completed with the results for the second loading of specimen holder 13. The irradiation conditions for this experiment carried out in a SIENA type capsule in the H.F.R. position E7 represent the conditions at the first wall of the NET (Next European Torus). 10 refs.; 6 figs.; 11 tabs.

15933 (ECN-R–90-007) **Self-shielding in the NET fusion reactor blanket and effects on uncertainty calculations.** Hogenbirk, A. Netherlands Energy Research Foundation, Petten (Netherlands). Nov 1990. 28p. Order Number DE91625342. Source: OSTI; NTIS (US Sales Only); INIS.

Task NSN1, subtask 3 of the European Fusion Technology Programme.

In this report the results are presented of an analysis of a NET iron/water inboard shielding blanket using energy self-shielded cross sections. Coupled (n,γ) transport calculations have been performed in an S_8P_8 approximation with the code ANISN using cross sections in the 121-group GAM-II structure. Basic cross sections were obtained from the 217-group MAT175 library, which is based on JEF-1 and EFF-1. Energy self-shielding was taken into account using the Bondarenko method. The results of this analysis are compared with those obtained in report ECN-C–90-034, in which a similar analysis had been presented using infinite dilute cross sections. It is shown that the effect of energy self-shielding on the neutron flux in the coils of the NET design is considerable, whereas the γ-flux is hardly influenced. Also the effect of using energy self-shielded cross sections in sensitivity and uncertainty analyses was studied. In these analyses the sensitivity of the total nuclear heating in the innermost interval of the inboard coils to the total cross sections of Fe, Cr and Ni has been studied. The analyses have been performed using an ECN-modified version of the code SENSIT. Due to the effect of self-shielding not only the value of the response parameter changes (the total nuclear heating in the coil increases with 13%), but also the associated relative uncertainty (the relative uncertainty due to uncertainties in the total cross sections of Fe, Cr and Ni decreases with 8%; the absolute value of the uncertainty increases however). The conclusion is that for reliable calculations of the nuclear heating the effects of self-shielding should be taken into account; for the uncertainty estimates this is less important. (author). 15 refs.; 15 figs.; 6 tabs.

15934 (ECN-RX–90-041) **Structural and metallurgical effects in stainless steel for first wall application in simulated**

plasma disruptions. Laan, J.G. van der (Netherlands Energy Research Foundation, Petten (Netherlands)); Klippel, H.T.; Bakker, J.; Stad, R.C.L. van der. Netherlands Energy Research Foundation, Petten (Netherlands). Jul 1990. 10p. (CONF-891204–: 4. international conference on fusion reactor materials, Kyoto (Japan), 4-8 Dec 1989). Order Number DE91625343. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted for publication in the Journal of Nuclear Materials.

This study presents experimental disruption simulation results using a pulsed high power laser beam with high energy density (0-20 MJ/m2) and short pulse duration (0.2-20 ms) under vacuum conditions. Time-dependent profiles of the laser beam are give. The paper deals mainly with the European reference heat austenitic steel type AISI 316L. The melting effects are quantified and compared with numerical predictions by a transient heat load code. The effects of repeated disruptions are analyzed. The extrapolation of experimental data obtained with small spots to predictions for larger areas is addressed. (author). 11 refs.; 6 figs.

15935 (ECN-RX–90-047) **Simulation and analysis of the response of carbon materials to off-normal heat loads accompanying plasma disruptions.** Laan, J.G. van der (Netherlands Energy Research Foundation, Petten (Netherlands)); Klippel, H.T. Netherlands Energy Research Foundation, Petten (Netherlands). Jul 1990. 10p. (CONF-891204–: 4. international conference on fusion reactor materials, Kyoto (Japan), 4-8 Dec 1989). Order Number DE91625344. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted for publication in the Journal of Nuclear Materials.

The effects of off-normal heat-loads accompanying plasma disruptions have been studied by both experimental and numerical simulations. Experiments have been performed on a range of polygranular graphites, pyrolytic graphite and carbon composite material. The measured erosion is compared with numerical predictions by a transient heat load code taking a revised value for the vaporization enthalpy of carbon. The effect of variations in thermophysical material parameters on thermal erosion behaviour is discussed. (author). 12 refs.; 5 figs.; 1 tab.

15936 (ECN-RX–90-051) **Simulation and analysis of the response of carbon fiber composites and pyrolytic graphites to off-normal high heat loads: Contribution to the 5th Workshop on carbon for fusion applications, KFA Juelich, 17-18 May 1990.** Laan, J.G. van der (Netherlands Energy Research Foundation, Petten (Netherlands)); Klippel, H.T.; Stad, R.C.L. van der; Bakker, J. Netherlands Energy Research Foundation, Petten (Netherlands). Aug 1990. 17p. (CONF-9005339–: 5. Workshop on carbon for fusion applications, Juelich (Germany, F.R.), 17-18 May 1990). Order Number DE91625345. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted for publication in Fusion Technology.

The response of plasma facing materials to off-normal high heat-loads expected in NET/ITER disruptions has been studied by both experimental and numerical simulations. Experiments have been performed on a number of pyrolytic graphites and carbon fiber composites. The measured erosion is compared with numerical predictions by a transient heat load code. The effect of variations in thermo-physical material parameters on thermal erosion behavior is discussed. On the surface of pyrolytic graphites cracking is observed, even below the erosion threshold. (author). 12 refs.; 8 figs.; 1 tab.

15937 (ECN-RX–90-053) **Status of radiation damage evaluation in fusion materials irradiation experiments.** Alberman, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)); Nolthenius, H.; Voorbraak, W.P. Netherlands Energy Research Foundation, Petten (Netherlands). Aug 1990. 10p. (CONF-900814–: 7. ASTM-EURATOM symposium on reactor dosimetry, Strasbourg (France), 27-31 Aug 1990). Order Number DE91625350. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted for publication.

The Euratom Working Group on Reactor Dosimetry (EWGRD) has issued several documents to establish standardized procedures and recommendations on neutron spectrum information, fluence measurements, damage cross section data, etc. This paper reviews suitable irradiation parameters for materials, in such way that experimental results obtained in a research reactor environment can be applied in the design of fusion power plants. Recent developments in fusion reactor technology programs and mainly the large European component qualification tests undertaken for NET have led to the EWGRD to consider new requirements. For radiation environments being quite different in fusion systems, compared to available test facilities, such as Material Testing Reactors or high-energy proton sources, classical dosimetry interpretation may be in-sufficient to assess proper damage correlations to fusion materials. Particularly the application to ceramics (tritium breeding blankets, insulators) addresses new requirements: damage to sublattices, relevance of 'dpa' as irradiation parameter, etc. This paper presents the status of available dosimetry methods, recommended cross sections and damage assessment, relevant for fusion technology materials irradiations. (author). 17 refs.; 1 fig.; 1 tab.

15938 (ECN-RX–90-062) **Sensitivity and uncertainty analysis of NET/ITER shielding blankets.** Hogenbirk, A. (Netherlands Energy Research Foundation, Petten (Netherlands)); Gruppelaar, H.; Verschuur, K.A. Netherlands Energy Research Foundation, Petten (Netherlands). Sep 1990. 8p. (CONF-900918–: 16. symposium on fusion technology (SOFT), London (UK), 3-7 Sep 1990). Order Number DE91625351. Source: OSTI; NTIS (US Sales Only); INIS.

Submitted for publication.

Results are presented of sensitivity and uncertainty calculations based upon the European fusion file (EFF-1). The effect of uncertainties in Fe, Cr and Ni cross sections on the nuclear heating in the coils of a NET/ITER shielding blanket has been studied. The analysis has been performed for the total cross section as well as partial cross sections. The correct expression for the sensitivity profile was used, including the gain term. The resulting uncertainty in the nuclear heating lies between 10 and 20 per cent. (author). 18 refs.; 2 figs.; 2 tabs.

15939 (ECN-RX–90-076) **Plasma sprayed titanium carbide coatings for first wall applications in fusion devices.** Groot, P. (Netherlands Energy Research Foundation, Petten (Netherlands)); Laan, J.G. van der; Mack, M.; Dvorak, M.; Huber, P. Netherlands Energy Research Foundation, Petten (Netherlands). Oct 1990. 21p. (CONF-891204–: 4. international conference on fusion reactor materials, Kyoto (Japan), 4-8 Dec 1989). Order Number DE91625346. Source: OSTI; NTIS (US Sales Only); INIS.

To appear in the Conference Proceedings and in The Journal of Nuclear Materials.

For protection applications in fusion devices thick TiC coatings are being developed. Coatings have been produced by plasma spraying at atmospheric pressure (APS), low pressure (LPPS) and in vacuum (VPS). Microstructural analysis of these TiC coatings includes X-ray diffraction, analysis of chemical composition, texture analysis and optical microscopy. Thermo-mechanical evaluation includes short pulse laser heat flux and thermal fatigue tests, simulating plasma disruptions. The effect of thickness, porosity and microstructure is discussed. (author). 5 refs.; 3 figs.; 2 tabs.

15940 (EGG-FSP–9435) **Preliminary analysis of uranium bed air-exposure test data.** Longhurst, G.R. EG and G Idaho, Inc., Idaho Falls, ID (USA). Dec 1990. 53p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. Order Number DE91010078. Source: OSTI; NTIS (US Sales Only); GPO Dep.

A series of experiments has been conducted at Ontario Hydro Research Division, Toronto, Ontario, Canada, to investigate the response of uranium storage beds for tritium to ingress of air. This project has been a cooperative activity involving Ontario Hydro, the Canadian Fusion Fuels Technology Project, the Princeton Plasma Physics Laboratory, and the Idaho National Engineering Laboratory. Experiments included test of 5-g and 25-g uranium beds in bench-scale experiments to characterize response characteristics and full-scale tests of a 3-kg uranium bed. Analyses of the bench-scale experiment data were performed and led to the prediction of the temperature excursion in the full-scale test with good accuracy. Chemical processes believed to be taking place within the beds when air is admitted include approximately stoichiometric reaction of the uranium with oxygen and nitrogen in the air to form UO and UN at lower temperatures and higher oxide states (UO_2 and U_2N_3) at higher temperatures. In most of the tests conducted the reaction

stopped after 30-50% of the uranium had reacted. The quenching process appears to be a combination of the effects of an oxide/nitride product film that hinders transport of the reactive gases to the uranium face and an inert gas blanketing at higher temperatures. There was no evidence of tritium escape in these tests. The conclusion is that the consequences of a single-ended air-ingress accident should not be catastrophic in the sense of large energy release of tritium release. 3 refs., 37 figs.

15941 (EGG-M–89512) **Hydrogen transport behavior of metal coatings for plasma facing components.** Anderl, R.A.; Holland, D.F.; Longhurst, G.R. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1990]. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-900505–15: 9. plasma surface interactions in controlled fusion devices conference, Bournemouth (UK), 20-25 May 1990). Order Number DE91010093. Source: OSTI; NTIS; INIS; GPO Dep.

Plasma-facing components for experimental and commercial fusion reactor studies may include cladding or coatings of refractory metals like tungsten on metallic structural substrates such as copper, vanadium alloys and austenitic stainless steel. Issues of safety and fuel economy include the potential for inventory buildup and permeation of tritium implanted into the plasma-facing surface. This paper reports on laboratory-scale studies with 3-keV D_3^+ ion beams to investigate the hydrogen transport behavior in tungsten coatings on substrates of copper. These experiments entailed measurements of the deuterium re-emission and permeation rates for tungsten, copper, and tungsten-coated copper specimens at temperatures ranging from 638 K to 825 K and implanting particle fluxes of approximately 5×10^{19} D/m^{2}s. Diffusion constants and surface recombination coefficients with enhancement factors due to sputtering were obtained from these measurements. These data may be used in calculations to estimate permeation rates and inventory buildups for proposed diverter designs. 18 refs., 3 figs., 3 tabs.

15942 (IAE–4992-8) **Neutron radiation field behind a nonuniform shield of thermonuclear reactors.** Zhirkin, A.V.; Sakharov, V.K.; Shatalov, G.E. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1990. 20p. (In Russian). Order Number DE91623766. Source: OSTI; NTIS (US Sales Only); INIS.

The fast neutron field characteristics outside of a homogenized iron-water shield with diagnostic channels peculiar to thermonuclear reactors (TNR) have been determined by the RNZ-4 code developed on the basis of the MORSE program. The results obtained have been analysed. The splitting and Russian roulette methods combined with exponential transformation and scattering angle shift were used in the calculations. The validity of the methods chosen and the reliability of the constant support were checked by comparison with experimental data. 7 refs.; 9 figs.; 1 tab.

15943 (INIS-SU–235, pp. 84-97) **Controlled heavy-ion fusion and deuterium targets.** Basko, M.M.; Imshennik, V.S.; Koshkarev, D.G.; Churazov, M.D.; Sherstnev, K.B. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 119p. (In Russian). In *Simulation of physical processes: Scientific-technical collection.* Order Number DE91003084. Source: OSTI; NTIS (US Sales Only); INIS.

The up-to-data state of works on inertial heavy-ion synthesis (IHIS) is described; basic physical principles of this direction of controlled heavy-ion synthesis are presented. Optimization problems are considered using the illustration of spherically-symmetrical target with tritium-deuterium fuel. Investigation of possibility to create deuterium-deuterium (DD) targets of IHIS is carried out. The structure of the cylindrical DD target with the use of magnetic heat insulation and detonation condition of DD fuel burning is suggested. 16 refs.; 7 figs.; 7 tabs.

15944 (INIS-SU–240, pp. 46-48) **On a possibility of realization of three-dimensional compression of an inhomogeneous liner.** Kosarev, V.I.; Lobanov, A.I.; Chukbar, K.V.; Shestakov, Yu.I. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1989. 75p. (In Russian). In *Thermonuclear synthesis: Scientific-technical collection.* Order Number DE91003079. Source: OSTI; NTIS (US Sales Only); INIS.

Two-dimensional (R,z) numerical calculation of plasma liner compression in the cone cavity, aimed at determining optimal initial configuration for achieving the maximal compression, was conducted. Three-dimensional energy concentration was provided during liner compression due to mass redistribution over its length. 7 refs.; 4 figs.

15945 (IPP–III/168) **Optimized control of the plasma position in the tokamaks ASDEX and TCV under consideration of the mains-dependent current rectifiers.** Schneider, F. Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.); Technische Univ. Muenchen (Germany, F.R.). Fakultaet fuer Elektrotechnik und Informationstechnik. Nov 1990. 117p. (In German). Order Number DE91764557. Source: OSTI; NTIS (US Sales Only); INIS.

An optimized plasma position control system for ASDEX and TCV tokamak is developed and tested. The problem is handled by the following contributions: A reliable measuring method for plasma position and shape; eigenvalue models describing the dynamics of the processes; introduction of replacing control parameters removing the discontinuities in the startup phase of the plasma current; development of time-dependently regulatable measurement and control matrices for set-point adjustment and decoupling of the control circuits; determination of methods for investigation and optimization of control circuits with mains-dependent current rectifiers; development of synchronizable, time-optimized regulators for circuits with mains-dependent current rectifiers; construction of computer programs for optimization of control circuits with tokamak plasmas. (AH).

15946 (KFK–4790) **Treating the neutronics of a (d,t)-fusion reactor operating on the tokamak principle (NET).** Fischer, U. Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik; Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.). Projekt Kernfusion; Karlsruhe Univ. (T.H.) (Germany, F.R.). Fakultaet fuer Maschinenbau. Oct 1990. 220p. (In German). Order Number DE91764474. Source: OSTI; NTIS (US Sales Only); INIS.

The primary aim of this work is to check the simplified one-dimensional neutronic approach being used frequently in design calculations. Therefore the neutronics of the NET (Next European Torus)-reactor is treated in a three-dimensional torus sector model by means of Monte Carlo calculations with the MCNP-code. Various blanket variants with different neutronic characteristics are taken into account. All of them had been developed for use in the NET-reactor: a ceramic solid breeder blanket using beryllium as neutron multiplier, a self-cooled liquid metal blanket using the eutectic alloy Pb-17Li or, alternatively, pure lithium as breeding material/coolant, and an aqueous lithium salt solution blanket. It is shown, that the one-dimensional approach can be applied in design calculations for evaluating power density distributions, if the plasma source is normalized in a consistent manner, if its spatial distribution is choosen appropriately, and, furthermore, if its angular dependence is taken into account. A three-dimensional treatment of the actual tokamak geometry, however, is necessary for determining the breeding performance of the blanket variants and for performing shielding calculations of the whole system blanket/shield. (orig./HP).

15947 (LA-UR–91-985) **Fast iterative technique for the calculation of frequency dependent gain in excimer laser amplifiers.** Sze, R.C. Los Alamos National Lab., NM (USA). [1991]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910123–20: OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium, Los Angeles, CA (USA), 20-25 Jan 1991). Order Number DE91009965. Source: OSTI; NTIS; INIS; GPO Dep.

The motivation in initiating these calculations is to allow us to observe the frequency evolution of a laser pulse as it propagates through an amplifier and then through a sequence of amplifiers. The question we seek to answer is what pulse shape do we need to produce out of a front-end oscillator so that after it propagates through the whole Aurora KrF fusion amplifier chain will result in high energy, broad-band laser fields of a given bandwidth that can

be focussed onto a fusion target. The propagation of a single frequency source through an amplifier with distributed loss was considered by Rigrod and was significantly expanded by Hunter and Hunter. The latter included amplified spontaneous emission [ASE] considerations both in the direction of and transverse to the coherent field. Analytic solutions that include forward and backward prapagating fields and ASE were derived which were transcendental in nature but allowed for fairly easy computer calculations. Transverse ASE were calculated using the unsaturated gain resulting from longitudinal fields and were used to compare this with the longitudinal field equations. Large computer programs are now available at LANL which include the influence of transverse ASE on the longitudinal fields. However, none of these considerations have worried about the changes in the frequency characteristics of the propagating field or of how each of the frequency field components contributes to the saturation of the gain. The inclusion of full frequency characteristics to the analytic solutions of Hunter and Hunter proved impossible at least for this author and a new calculational technique was developed and is the subject of this talk.

15948 (LBL–29743) **Heavy Ion Fusion Accelerator Research (HIFAR) year-end report, April 1, 1990–September 30, 1990.** Lawrence Berkeley Lab., CA (USA). Dec 1990. 25p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00098. (HIFAN–478). Order Number DE91010206. Source: OSTI; NTIS; INIS; GPO Dep.

The basic objective of the Heavy Ion Fusion Accelerator Research (HIFAR) program is to assess the suitability of heavy ion accelerators as igniters for Inertial Confinement Fusion (ICF). A specific accelerator technology, induction acceleration, is being studied at the Lawrence Berkeley Laboratory and at the Lawrence Livermore National Laboratory. The HIFAR program addresses the generation of high-power, high-brightness beams of heavy ions, the understanding of the scaling laws in this novel physics regime, and the validation of new accelerator strategies to cut costs. Key elements to be addressed include: (1) beam quality limits set by transverse and longitudinal beam physics; (2) development of induction accelerating modules, and multiple-beam hardware, at affordable costs; (3) acceleration of multiple beams with current amplification without significant dilution of the optical quality of the beams; (4) final bunching, transport, and accurate focusing on a small target.

15949 (NIFS-WS–2) **International panel on 14 MeV intense neutron source based on accelerators for fusion material study: Proceedings.** Miyahara, A. (National Inst. for Fusion Science, Nagoya (Japan)); Wiffen, W.F. National Inst. for Fusion Science, Nagoya (Japan). [1991]. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. (CONF-910169–Summ.: International panel on 14 MeV intense neutron source based on accelerators for fusion material studies, Tokyo (Japan), 14-16 Jan 1991). Order Number DE91009935. Source: OSTI; NTIS; INIS; GPO Dep.

The International Panel on 14 MeV Intense Neutron Source Based on Accelerators for Fusion Materials Study was held January 14–16, 1991, at the Department of Nuclear Engineering, the University of Tokyo. The panel was attended by 38 participants, including 9 from the US, 3 from the EC, and 1 from Canada. This meeting had initially been planned as a bilateral US-Japan workshop, but was expanded to international participation in response to the recently issued FPAC report in the US and the FPEB report in the EC. Both of these documents proposed schedules for the DEMO fusion reactor that present a challenge for the materials community, and restated the importance of the required materials development and the necessity of an international 14 MeV neutron source for the development of the magnetic fusion energy option. The scope of the panel was restricted to source concepts judged to be practical within the next five years little further development. The goals of the panel were to reach a consensus on a practical approach, to collect information on accelerator based concepts, to list critical issues, and to produce tentative schedules for design and development of a neutron source. Most of the panel presentations and discussions were on the d-Li approach to neutron source. The status of the FMI project at its termination and the advance in accelerator technology and target concepts since the time were summarized. No feasibility questions remaining with this approach were seen, but high power beam-on-target verification tests and demonstration of accelerator performance limits remain to be accomplished.

15950 (ORNL/FEDC–90/3) **Radiation analysis of the ITER pellet injection system.** Gouge, M.J. (Oak Ridge National Lab., TN (USA)); Gomes, I.C.; Gomes, L.T.; Stevens, P.N,. Oak Ridge National Lab., TN (USA). Fusion Engineering Design Center. Mar 1991. 31p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010485. Source: OSTI; NTIS; INIS; GPO Dep.

The results of neutronics calculations for the pellet injection system of the International Thermonuclear Experimental Reactor (ITER) are described. Hands-on maintenance of components in the pellet injection room results in a considerable simplification of maintenance support equipment and in greater system availability. The basic configuration of the pellet injection system includes small-diameter guide tubes with which the pellet may have several small-angle collisions before reaching the plasma. The pellet injector port through which the guide tubes pass will be shared with ITER plasma diagnostics, so the calculation takes into account penetrations to accommodate numerous channels for a neutron spectrometer and neutron and gamma-ray cameras. The conservative assumption of steady-state operation of ITER for 1000 days was taken as the baseline for calculating the activation of components in the pellet injection room. The plasma configuration is based on the current ITER guidelines, the first wall configuration is based on the most recently updated configuration, and the blanket configuration is based on the US proposal for the blanket. The plasma, coils, and blanket regions were analyzed with the Monte Carlo code MCNP. The transport of neutrons through the penetrations was also performed with MCNP. The pellet injection room was modeled with the two-dimensional discrete ordinates code DORT, which was also used for the transport of neutrons during operation and of gamma rays caused by activation. The activation calculations were carried out with the REBATE code. Results from this study indicate that restricted personnel access to the pellet injection room is possible, so limited hands-on maintenance can be performed on the majority of the components in the room.

15951 (SAND–89-1929) **Ion beam testing of the Aerolor X-point dump plate for the Joint European Torus.** Salmonson, J.C.; Watkins, J.G.; Watson, R.D.; McDonald, J.M. Sandia National Labs., Albuquerque, NM (USA). Jan 1991. 26p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91010719. Source: OSTI; NTIS; INIS; GPO Dep.

The durability of a carbon-carbon composite, Aerolor A05, X-point divertor dump plate to thermal fatigue was evaluated for the Joint European Torus (JET) at Sandia's Plasma Material Test Facility. Of primary interest was the effect of thermal cycling on the carbon-carbon threads of the bolted attachment scheme for the Aerolor X-point divertor. This report describes the testing performed at the Ion Beam Test System and the test and analysis results obtained in support of this effort. After completing 1000 thermal cycles, where the surface temperature of the 8 cm by 8 cm by 2.3 cm Aerolor tile reached 2200°C during a 10 s, 500 W/cm^2 pulse, the tile survived without any noticeable damage. Post test inspection of the carbon-carbon threads showed only minor wear and no signs of significant damage. Thermal modeling of the test article using the ABAQUS finite element code agreed very well with experimental results. The thermal creep experienced by the M-12 stainless steel bolt during ion beam testing will not be expected to occur during normal operations in JET because of the longer cycle times between the thermal events. Finite element analysis indicates that the longer cycle times at the JET will reduce the peak temperatures in the vicinity of the bolt and bolt insert below the level at which thermal creep would occur. An additional margin of safety could be obtained by using Inconel or Nimonic fasteners. Overall, the performance of the bolted divertor design to thermal fatigue was acceptable. 12 figs., 2 tabs.

15952 (SAND–90-2357C) **Plasma-sprayed materials for magnetic fusion energy devices.** Smith, M.F.; Croessmann, C.D.; Hosking, F.M.; Watson, R.D.; Koski, J.A. Sandia National Labs., Albuquerque, NM (USA). [1991]. 10p. Sponsored by USDOE,

Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9106148–1: 2. plasma-technik symposium, Lucerne (Switzerland), 5-7 Jun 1991). Order Number DE91010476. Source: OSTI; NTIS; GPO Dep.

Plasma spray technology is being evaluated as a means to address important fabrication and maintenance problems associated with plasma-interactive components in magnetic fusion devices (e.g., limiters, divertors, and some first wall surfaces). Low-oxygen vacuum plasma sprayed copper has been tested as a ductile, high thermal conductivity interlayer to limit thermal stress and prevent cracking when brazing pyrolytic graphite (PG) tiles to high-strength metal cooling tubes. A brazed tile/tube assembly with this sprayed interlayer has survived thermal testing up to a surface heat flux of 2.0 kW cm^{-2} as computed on the basis of the power removed in the sample cooling water. A vacuum-sprayed, tungsten-wire-reinforced, copper composite has also been studied as a means to produce an interlayer with highly anisotropic thermal expansion similar to that of PG. Beryllium and tungsten are the present alternatives to graphite for plasma-facing surfaces. High heat flux testing of plasma-sprayed beryllium samples indicates that adhesion and thermal conductivity must be improved. Plasma-sprayed tungsten has performed well in thermal tests, but other factors may rule out the use of tungsten in near term fusion devices. 6 refs., 6 figs., 1 tab.

15953 (SAND–91-0043C) **Intense light-ion beams provide a robust, common-driver path towards ignition, gain and commercial fusion energy.** Ramirez, J.J. (Sandia National Labs., Albuquerque, NM (USA)); Cook, D.L.; Rice, J.K.; Matzen, M.K.; Johnson, D.L.; Boyes, J.D.; Olson, C.L.; Prestwich, K.R.; Clauser, M.J.; Mehlhorn, T.A.; Stinnett, R.W.; Allshouse, G.O.; Kulcinski, G.L.; Moses, G.A.; PeteSandia National Labs., Albuquerque, NM (USA). [1991]. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-9104210–1: International Atomic Energy Agency (IAEA) technical committee meeting on drivers for inertial confinement fusion (ICF), Osaka (Japan), 15-19 Apr 1991). Order Number DE91010584. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Intense light-ion beams are being developed for investigations of Inertial Confinement Fusion (ICF). This effort has concentrated on developing the Particle Beam Fusion Accelerator II (PBFA-II) at Sandia as a driver for ICF target experiments, on design concepts for a high-yield, high-gain Laboratory Microfusion Facility (LMF), and on a comprehensive system study of a light-ion beam driven commercial fusion reactor (LIBRA). This paper reports on the status of design concepts and research in these areas. 8 refs., 6 figs.

15954 (UCRL-JC–104981-Rev.1) **3D particle simulation of beams using the WARP code: Transport around bends: Revision 1.** Friedman, A. (Lawrence Livermore National Lab., CA (USA)); Grote, D.P.; Callahan, D.A.; Langdon, A.B.; Haber, I. Lawrence Livermore National Lab., CA (USA). 15 Mar 1991. 15p. Sponsored by Department of Defense, Washington, DC (USA); USDOE, Washington, DC (USA); Lawrence Berkeley Lab., CA (USA). DOE Contract W-7405-ENG-48 ;AC03-76SF00098. (CONF-901219–6-Rev.: International symposium on heavy ion inertial fusion, Monterey, CA (USA), 3-6 Dec 1990). Order Number DE91010464. Source: OSTI; NTIS (US Sales Only); GPO Dep.

WARP is a discrete simulation program which was developed for studies of space-charge-dominated ion beams. It combines features of an accelerator code and a particle-in-cell plasma simulation. The code architecture, and techniques employed to enhance efficiency, are briefly described. Current applications are reviewed. In this paper we emphasize the physics of transport of three-dimensional beams around bends. We present a simple bent-beam PIC algorithm. Using this model, we have followed a long, thin beam around a bend in a simple racetrack system (assuming straight-pipe self-fields). Results on beam dynamics are presented; no transverse emittance growth (at mid-pulse) is observed. 12 refs., 5 figs.

15955 (UWFDM–850) **SIRIUS-T: A study of a symmetrically illuminated inertial confinement fusion tritium production facility: Final report.** Badger, B.; Sviatoslavksy, I.N.; Bruggink, D.; Engelstad, R.L.; Kulcinski, G.L.; Larsen, E.M.; Lovell, E.G.; MacFarlane, J.J.; Mogahed, E.A.; Moses, G.A.; Moucha, A.; Peterson, R.R.; Powers, J.; Sawan, M.E.; Wittenberg, L.J. Wisconsin Univ., Madison, WI (USA). Fusion Technology Inst. Dec 1990. 235p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AS03-88DP10754. Order Number DE91009263. Source: OSTI; NTIS; GPO Dep.

The aging US tritium production reactors are slowly being phased out and the US Department of Energy has initiated a "New Production Reactors Program" which will provide for the design, construction and operation of new facilities for the production of tritium and other special nuclear materials. Preliminary requirements are currently being prepared, leading to construction and operation by the year 2000. Unfortunately, inertial confinement fusion (ICF) cannot possibly be ready to perform such a task on this short time scale. However, it is instructive to see how well it can do in producing tritium when ICF has been demonstrated and a comparison with the proposed production schemes is conducted here. SIRIUS-T is conceptual design study of a tritium production facility utilizing direct drive symmetrically illuminated inertial confinement fusion. The "T" designation distinguishes it from SIRIUS-M, a materials facility, and SIRIUS-C, a commercial power plant. As in any other fusion related design study, a certain amount of technical extrapolation has been made in SIRIUS-T. It should be said early on, however, that in areas of uncertainty, we have always taken the conservative approach. This is evident in our choice of target gain, number of beams selected for symmetric illumination and elsewhere throughout the study. In performing the economic analysis we have also attempted to err on the conservative side. This too is evident in our costing of the driver and the reactor chamber. For these reasons, we feel that this study projects enough confidence as to make it worthy of comparison with the other proposed production systems.

99 GENERAL AND MISCELLANEOUS

15956 (FNAL-TM–1722) **Education programs at the DOE national laboratories: Benefits to teachers and students.** Bardeen, M.G. Fermi National Accelerator Lab., Batavia, IL (USA). Mar 1991. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH03000. (CONF-910340–4: International industrial symposium on the super collider, Atlanta, GA (USA), 13-15 Mar 1991). Order Number DE91010324. Source: OSTI; NTIS; GPO Dep.

In 1980, when Fermilab began supporting precollege education programs, it was not at all clear that a research laboratory was an appropriate setting for major precollege education programs. Participants have given us the answer, "Yes!" Programs for students and teachers work at national laboratories because it is not business as usual. Participants come to a world class research laboratory for a unique opportunity to witness science conducted at the frontier of human understanding. They gain invaluable experience being in an environment where science is done. We have shown that teachers, in particular, respond positively to being treated as professionals and peers by researchers. Benefits to teachers and students from participating in a national laboratory's education programs may be broadly categorized as either changed attitudes toward science or new knowledge about science and science teaching and will be described.

9901 Management

Refer also to citation(s) 14622, 14735

15957 (BNL–45929) **An Organizational Cultural Assessment of Princeton Plasma Physics Laboratory.** Haber, S.B.; Crouch, D.A. Brookhaven National Lab., Upton, NY (USA). 15 Mar 1991. 71p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC02-76CH00016. Order Number DE91010981. Source: OSTI; NTIS; GPO Dep.

An Organizational Cultural Assessment (OCA) was performed at the Princeton Plasma Physics Laboratory (PPPL) by administering an Organizational Culture Survey (OCS) that queried employees on the subjects of organizational culture, various aspects of communications, employee commitment, work group cohesion, coordination of work, environmental concerns, hazardous nature of work, safety and overall job satisfaction. Many of these subjects are assessed in the OCS through highly developed and validated

scales that have been administered in many different types of organizations. Some of the issues, especially the questions on environmental, safety and health concerns, are newly developed and are still being modified. The purpose of the OCS is to measure in a quantitative and objective way the notion of "culture;" that is, the values, attitudes, and beliefs of the individuals working within the organization. In addition, through the OCS, a broad sample of individuals can be reached that would probably not be interviewed or observed during the course of a typical assessment. The OCS also provides a descriptive profile of the organization at one point in time that can then be compared to a profile taken at a different point in time to assess changes in the culture of the organization.

15958 (DOE/AD–0005) **Information Resources Management long-range plan: FY 1992–FY 1996.** USDOE Office of Administration and Human Resource Management, Washington, DC (USA). Office of Information Resources Management Policy, Plans, and Oversight. Dec 1990. 269p. Sponsored by USDOE, Washington, DC (USA). Order Number DE91009745. Source: OSTI; NTIS; GPO Dep.

The Information Resources Management (IRM) activities which support the diverse programmatic missions in the Department of Energy are complex. IRM requirements are continually changing to reflect changes in technology, policy, and program mission. Long-range planning for IRM has been developed to assure that adequate support is available for cost-effective accomplishment of mission objectives. IRM is vital to the successful accomplishment of the programmatic missions in the Department. This is evidenced by the fact that the estimated information technology resources (ITR) cost for FY 1991, approximately $1.58 billion, is about 9 percent of the total Departmental FY 1991 budget request, while the total estimated ITR cost for the entire Federal Government is less than 1.7 percent of the total Federal budget request for the same time period. Recognizing the ever-increasing importance of IRM to the Department, activities in this area were reorganized this year. This reorganization centralized IRM within DOE and created a clear division of responsibility between policy and operations. Management of the information technology resources within IRM (e.g., information systems, computing resources, and telecommunications) were consolidated with printing and publishing activities, records management, IRM standards, and telecommunications and unclassified computer security. The Office of Scientific and Technical Information continues to have the responsibility for information management support and direction for DOE's scientific and technical information. This Plan reflects this transition and, therefore, incorporates information on other areas of IRM, where information is available. The management plan and status of information Systems, Computing Resources and Telecommunication Systems is provided with charts and graphs. 40 refs., 57 figs., 22 tabs.

15959 (INIS-GB–345) **HM Nuclear Installations Inspectorate: a bibliography of published work, 1962-1987.** McNichol, K. (comp.). Health and Safety Executive, Sheffield (UK). Apr 1988 52p. Order Number DE91626188. Source: OSTI; NTIS (US Sales Only); INIS.

Amendments dated Mar 1989 (3 p.) and May 1990 (2 p.) are enclosed.

This bibliography contains references to published reports, conference papers and journal articles produced by individual members of the Nuclear Installations Inspectorate and the Inspectorate as a whole. The bibliography has been compiled from records held by the Health and Safety Executive Library and Information Service. All items have been indexed in HSELINE, HSE's publicly available database. The bibliography is arranged in 2 parts: by author(s) and by subject. (author).

15960 (INIS-mf–12181) **GSF annual report 1988. Lectures, publications, conference papers, guest lectures, addresses.** Gesellschaft fuer Strahlen- und Umweltforschung mbH Muenchen, Neuherberg (Germany, F.R.). 1989 98p. (In German). Order Number DE91764342. Source: OSTI; NTIS (US Sales Only); INIS.

The annual report contains publications and lectures of GSF-staff as well as guest lectures within the GSF in alphabetical order. (DG).

15961 (INIS-mf–12803) **IGC highlights 1988.** Indira Gandhi Centre for Atomic Research, Kalpakkam (India). 1989 84p. Order Number DE91625178. Source: OSTI; NTIS (US Sales Only); INIS.

The major thrust of the research and development (R and D) activities of the Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam is oriented towards mastering fast breeder reactor (FBR) technology. Towards this end, its current R and D activities are carried out in a wide variety of disciplines. Highlights of its R and D activities during 1988 are summarised under the headings: Reactor Engineering and Design, Reactor Physics and Safety, Materials Science and Technology, Sodium Chemistry and Technology, Fuel Reprocessing and Electronics and Instrumentation. The text is illustrated with a number of figures, graphs and coloured pictures. (M.G.B.). figs., tabs.

15962 (INIS-mf–12804) **Bhabha Atomic Research Centre annual report : 1989.** Bhabha Atomic Research Centre, Bombay (India). 1991 140p. Order Number DE91625179. Source: OSTI; NTIS (US Sales Only); INIS.

The main thrust of the various research and development (R and D) activities of the Bhabha Atomic Research Centre (BARC), Bombay, is towards the implementation of India's nuclear power programme. To that end, its R and D activities cover the entire nuclear fuel cycle, reactor technology; applications of radioisotopes and radiations in agriculture, medicine and industries; and radiation protection in nuclear installations. The report presents in summarised form the R and D activities carried out during 1989 in the chapters entitled: Physical Sciences, Chemical Sciences, Materials and Materials Sciences, Radioisotopes, Reactors, Fuel Cycle, Radiological Safety and Protection, Electronics and Instrumentation, Engineering Services, Life Sciences and General. At the end of each chapter, a list of publications by the staff scientists in the corresponding subject field is given. The list includes published journal articles and technical reports, and papers presented at conferences, symposia etc. The report also covers the R and D activities of the outstation units of BARC, namely, Nuclear Research Laboratory, Srinagar; High Altitude Research Laboratory, Gulmarg; and Variable Energy Cyclotron Centre, Calcutta. BARC is also engaged in basic an applied research in frontier areas of science such as plasma and fusion physics, accelerators and lasers, high temperature superconductivity, condensed matter physics, high pressure physics, high resolution spectroscopy, chemical reaction dynamics and laser induced chemistry, electronics and robotics: radiation biology, and genetic engineering. Report is illustrated with a number of figures, graphs, and coloured pictures. (M.G.B.) figs., refs.

15963 (RISO-R–579) **Department of Energy Technology. Annual progress report 1 January - 31 December 1989.** Micheelsen, B.; Hoejerup, C.F. (eds.). Risoe National Lab., Roskilde (Denmark). Sep 1990. 42p. Order Number DE91625180. Source: OSTI; NTIS (US Sales Only); INIS.

The general development of the Department of Energy Technology at Risoe during 1989 is presented. This year was the last one for the department, as organizational changes at the beginning of 1990 caused a split-up of the sections of the department. The activities within the major fields are described in some detail and lists of staff and publications are included. (author) 10 ills., 29 refs.

15964 (UPTEC–90-110R) **Annual report 1989/1990.** Uppsala Univ. (Sweden). Inst. of Tech. Dec 1990. 60p. Order Number DE91626194. Source: OSTI; NTIS (US Sales Only); INIS.

This report gives a survey of the present research projects within the division of Solid state physics, Inst of Technology, Uppsala University and the progress that was made during the academic year 1989/90. The projects reported fall within the fields of magnetic properties and relaxation phenomena in spin glasses, high temperature superconductors, magnetism in itinerant systems, as well as optical selectivity of oxidized metals, multilayers and light scattering from inhomogenous systems. (author).

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Refer also to citation(s) 14223, 14307, 14308, 14311, 14481, 14522, 14542, 14575, 14577, 14586, 14650, 14656, 14705, 14813, 14890, 14986, 14997, 14998, 15000, 15011, 15013, 15016, 15028,

15064, 15125, 15129, 15130, 15199, 15204, 15207, 15250, 15265, 15266, 15444, 15445, 15446, 15497, 15511, 15513, 15514, 15519, 15520, 15557, 15759, 15761, 15781, 15818, 15863, 15870, 15871, 15922, 15928, 15954, 16005, 16007, 16010, 16022, 16025, 16026, 16027

15965 (ANL/CP–72651) **Visual presentation and computer animation.** Wang, Hua. Argonne National Lab., IL (USA). [1991]. 9p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. (CONF-9103133–2: 7. international conference on advanced science and technology, Argonne, IL (USA), 30 Mar 1991). Order Number DE91010599. Source: OSTI; NTIS; GPO Dep.

This paper presents an assessment of the current computer graphics and video technologies as they applied to the fields of visual presentation and computer animation, including a discussion of inherent incompatibilities between computer graphics and video systems. The near-term technology trend is directed towards the integration of sound, video and computer graphics into a multimedia, desktop presentation system. With the forthcoming High-Definition Television (HDTV) standard, it can be predicted that computer graphics and video will eventually be integrated to a desktop video system. Recent advances in technology development to achieve these goals are described. 3 tabs.

15966 (ANL/TM–486) **An Assessment of Scientific Computing Technology 1991-2001.** Mueller, C.J.; Amiot, L.W.; Canfield, T.R.; Caruthers, C.M.; Kuhfuss, T.C.; Lusk, E.L.; McMahon, R.J.; Malon, D.M.; Minkoff, M.; Moszur, F.M.; Padua, D.A.; Plaskacz, E.J.; Rowlan, J.; Stevens, R.L.; Volmer, J.A. Argonne National Lab., IL (USA). Feb 1991. 58p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. Order Number DE91009819. Source: OSTI; NTIS; GPO Dep.

This report discusses the future computing technology at Argonne National Laboratory. Some of the areas covered are: computational science needs: the grand challenges; scientific computing hardware; software: languages and tools; fortran and compilers for parallel computers; networking and communications; and scientific visualization.

15967 (CERN–90-06) **1989 CERN school of computing: Proceedings.** Verkerk, C. (ed.). European Organization for Nuclear Research, Geneva (Switzerland). 29 May 1990. 357p. (CONF-8908204–: CERN school of computing conference, Bad Herrenalb (Germany, F.R.), 20 Aug - 2 sep 1989). Order Number DE91625148. Source: OSTI; NTIS (US Sales Only); INIS.

These Proceedings contain written versions of lectures delivered at the 1989 CERN School of Computing and covering a variety of topics. Vector and parallel computing are the subjects of five papers: experience with vector processors in HEP; scientific computing with transputers; applications of large transputer arrays; neutral networks and neurocomputers; and Amdahl's scaling law. Data-acquisition and event reconstruction methods were covered in two series of lectures reproduced here: microprocessor-based data-acquisition systems for HERA experiments, and track and vertex fitting. Two speakers treated applications of expert systems: artificial intelligence and expert systems - applications in data acquisition, and application of diagnostic expert systems in the accelerator domain. Other lecture courses covered past and present computing practice: 30 years of computing at CERN, and information processing at the Aerospace Institute in the Federal Republic of Germany. Other papers cover the contents of lectures on: HEPnet, where we are and where we are going; ciphering algorithms; integrated circuit design for supercomputers; GaAs versus Si, theory and practice; and an introduction to operating systems. (orig.).

15968 (CONF-910648–1) **A first-principles generic methodology for representing the knowledge base of a process diagnostic expert system.** Reifman, J.; Briggs, L.L.; Wei, T.Y.C. Argonne National Lab., IL (USA). [1990]. 19p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. From 4. international conference on industrial and engineering applications of artificial intelligence and expert systems; Kauai, HI (USA); 2-5 Jun 1991. Order Number DE90017693. Source: OSTI; NTIS; INIS; GPO Dep.

In this paper we present a methodology for identifying faulty component candidates of process malfunctions through basic physical principles of conservation, functional classification of components and information from the process schematics. The basic principles of macroscopic balance of mass, momentum and energy in thermal hydraulic control volumes are applied in a novel approach to incorporate deep knowledge into the knowledge base. Additional deep knowledge is incorporated through the functional classification of process components according to their influence in disturbing the macroscopic balance equations. Information from the process schematics is applied to identify the faulty component candidates after the type of imbalance in the control volumes is matched against the functional classification of the components. Except for the information from the process schematics, this approach is completely general and independent of the process under consideration. The use of basic first-principles, which are physically correct, and the process-independent architecture of the diagnosis procedure allow for the verification and validation of the system. A prototype process diagnosis expert system is developed and a test problem is presented to identify faulty component candidates in the presence of a single failure in a hypothetical balance of plant of a liquid metal nuclear reactor plant.

15969 (CONF-9104165–1) **Hybrid system for fault diagnosis using scanned input: A tutorial.** Ferrada, J.J. (Oak Ridge National Lab., TN (USA)); Osborne-Lee, I.W.; Grizzaffi, P.A. Oak Ridge National Lab., TN (USA). [1991]. 27p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From National American Institute of Chemical Engineers (AIChE) meeting; Houston, TX (USA); 7-11 Apr 1991. Order Number DE91009558. Source: OSTI; NTIS; GPO Dep.

It is well known that expert systems are useful in capturing expertise and applying knowledge to chemical engineering problems such as diagnosis, process control, process simulation, and process analysis. Traditionally, expert system applications are limited to knowledge domains that are heuristic and involve only simple mathematics. Neural networks, however, represent an emerging technology capable of rapid recognition of patterned behavior without regard to mathematical complexity. Although useful in problem identification, neutral networks are not very efficient in pointing to in-depth solutions and typically do not promote a profound understanding of the problem or the reasoning behind its solutions. This paper explores the potential for expanding the scope of expert system applications by combining expert systems with neural networks. Any computer system that is partly an expert system and partly a neural network can be called a hybrid system. This pairing is a natural one because where one system falls short the other excels. Imprecise (or even incomplete) data can submitted to a neutral network for classification. Once these data are classified, the results are not always as precise as need dictates. It is at this point that the expert system can be invoked to do what it does best: take definite and complete, but general, input and produce a definite and precise output. This paper presents a relatively new approach–one that expands the scope of artificial intelligence (AI) applications by combining expert systems and neural networks to form a hybrid system. A general methodology for developing hybrid systems is given. The methodology and merits of developing hybrid systems are illustrated through a case study.

15970 (CONF-9104179–1) **Development of a general-purpose, integrated knowledge capture and delivery system.** Roberts, A.G.; Freer, E.B. Oak Ridge National Lab., TN (USA). [1991]. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. From Petrochemical exposition; Houston, TX (USA); 9-11 Apr 1991. Order Number DE91009630. Source: OSTI; NTIS; GPO Dep.

KATIE (Knowledge-Based Assistant for Troubleshooting Industrial Equipment) was first conceived as a solution for maintenance problems. In the area of process control, maintenance technicians have become responsible for increasingly complicated equipment and an overwhelming amount of associated information. The sophisticated distributed control systems have proven to be such a drastic change for technicians that they are forced to rely on the engineer for troubleshooting guidance. Because it is difficult for a

knowledgeable engineer to be readily available for troubleshooting,maintenance personnel wish to capture the information provided by the engineer. The solution provided has two stages. First, a specific complicated system was chosen as a test case. An effort was made to gather all available system information in some form. Second, a method of capturing and delivering this collection of information was developed. Several features were desired for this knowledge capture/delivery system (KATIE). Creation of the knowledge base needed to be independent of the delivery system. The delivery path need to be as simple as possible for the technician, and the capture, or authoring, system could provide very sophisticated features. It was decided that KATIE should be as general as possible, not internalizing specifics about the first implementation. The knowledge bases created needed to be completely separate from KATIE needed to have a modular structure so that each type of information (rules, procedures, manuals, symptoms) could be encapsulated individually.

15971 (CONF-9106103–1) **Table-lookup algorithms for elementary functions and their error analysis.** Tang, Ping Tak Peter. Argonne National Lab., IL (USA). [1991]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-31109-ENG-38. From 10. Institute of Electrical and Electronics Engineers (IEEE) symposium on computer arithmetic; Grenoble (France); 26-28 Jun 1991. Order Number DE91006047. Source: OSTI; NTIS; GPO Dep.

Table-lookup algorithms for calculating elementary functions offer superior speed and accuracy when compared with more traditional algorithms. With careful design, we show that it is feasible to implement table-lookup algorithms in hardware. Furthermore, we present a uniform approach to carry out tight error analysis for such implementations. 7 refs.

15972 (EGG–10617-5072) **Consistency of effective-bits calculations.** Tunnell, T. EG and G Energy Measurements, Inc., Los Alamos, NM (USA). Los Alamos Operations. 26 Nov 1990. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC08-88NV10617. (LAO–2732-2046). Order Number DE91010772. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This memorandum documents our preliminary work in assessing the accuracy of the SINEFIT code we use to compute effective bits. The accuracy of effective-bits calculations has become a feature that we want to determine in our digitizer testing project. In our study we are finding that the frequency instabilities of the signal generator may impair the ability of the sine-fitting algorithms to calculate effective bits accurately for large data sets at high frequencies. This does not yet appear to be a problem. However, as digitizer acquisition rates are increased, the current signal generators may not be adequate for determining effective bits. Finally, we show how we can use the consistency of the effective-bits calculations of other quantities (such as frequency) to estimate the accuracy in computing fixed-time-base errors. 3 refs.

15973 (EGG–10617-5083) **Expected errors computed from effective bits.** Tunnell, T. EG and G Energy Measurements, Inc., Los Alamos, NM (USA). 22 Oct 1990. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC08-88NV10617. (LAO–2732-2020). Order Number DE91010826. Source: OSTI; NTIS; GPO Dep.

This memorandum has two purposes. The first is to review how we can calculate error bars for a given data set from the effective-bits measurements. The second is to outline how we can use the error bars to quantify expected errors in linear fits to data, integrated data, and power spectral densities computed from data. The expected errors for these quantities are calculated using standard statistics and probability techniques.

15974 (EGG-M–90462) **Successful neural network projects at the Idaho National Engineering Laboratory.** Cordes, G.A. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1991]. 14p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC07-76ID01570. (CONF-9105157–2: 6. annual Goddard conference on space applications of artificial intelligence, Greenbelt, MD (USA), 13-15 May 1991). Order Number DE91010092. Source: OSTI; NTIS; INIS; GPO Dep.

This paper presents recent and current projects at the Idaho National Engineering Laboratory (INEL) that research and apply neural network technology. The projects are summarized in the paper and their direct application to space reactor power and propulsion systems activities is discussed. 9 refs., 10 figs., 3 tabs.

15975 (IAE–4670-16) **Techniques for realization of application programming systems based on the initial data macrogeneration.** Ostashenko, S.V. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii. 1988. 55p. (In Russian). Order Number DE91625149. Source: OSTI; NTIS (US Sales Only); INIS.

The work shows that the employment of the external definitions for the initial values of data in FORTRAN (BLOCK DATA) makes it possible with certain programming techniques used to lift the restriction on memory without recource to the system functions. The initial values of data can be generated by a macroprocessor which at the same time becomes a problem-oriented input language processor. The realization of the language to describe the geometry of the GDL reactor assemblies is described. The MORTRAN language is proposed to be used as a part of the procedure. It is shown that the method allows one to perform the automated integration of the programs executed from modules on the basis of the problem-oriented input data of the supplement. The POL system to construct the transperable language processors of the selected class is described. 15 refs.

15976 (IAEA-NDS–79(Rev.1)) **Program PLOTC4. (Version 87-1). Plot evaluated data from the ENDF/B format and/or experimental data which is in a computation format.** Cullen, D.E. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Jun 1987. 45p. Order Number DE91625150. Source: OSTI; NTIS (US Sales Only); INIS.

Experimental and evaluated nuclear reaction data are world-wide compiled in EXFOR format (see document IAEA-NDS-1) and ENDF format (see document IAEA-NDS-10), respectively. The computer program PLOTC4 described in the present document plots data from both formats; EXFOR data must be converted first to a "computation format" (see document IAEA-NDS-80). The program is available upon request costfree from the IAEA Nuclear Data Section. (author).

15977 (IAEA-NDS–81(Rev.0)) **COMPUTATION FORMAT computer codes X4TOC4 and PLOTC4. Implementing and Testing on a Personal Computer.** McLaughlin, P.K. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. May 1987. 21p. Order Number DE91625151. Source: OSTI; NTIS (US Sales Only); INIS.

This document describes the contents of the diskette containing the COMPUTATION FORMAT codes X4TOC4 and PLOTC4 by D.E. Cullen, and example data for use in implementing and testing these codes on a Personal Computer of the type IBM-PC/AT. Upon request the codes are available from the IAEA Nuclear Data Section, free of charge, on a single diskette. (author).

15978 (IAEA-NDS–82(Rev.0)) **Program PLOTTAB. (Version 87-2). General plotting program to plot any combination of continuous curves and/or discrete points (with associated error bars).** Cullen, D.E. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Jun 1987. 48p. Order Number DE91625152. Source: OSTI; NTIS (US Sales Only); INIS.

This program is designed to be a general application independent plotting program to plot any combination of continuous curves and/or discrete points (with associated error bars) using user supplied titles and x and y axis labels and units. Using this method the program has no idea what data is being plotted and yet the user can produce any number of plots with each plot properly identified. This program is available upon request costfree from the IAEA Nuclear Data Section. (author).

15979 (IAEA-NDS–83(Rev.1)) **Implementing and testing program PLOTTAB.** Cullen, D.E.; McLaughlin, P.K. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Jan 1988. 15p. Order Number DE91625153. Source: OSTI; NTIS (US Sales Only); INIS.

Enclosed is a description of the magnetic tape or floppy diskette containing the PLOTTAB code package. In addition detailed information is provided on implementation and testing of this code. See

part I for mainframe computers; part II for personal computers. These codes are documented in IAEA-NDS-82. (author).

15980 (IAEA-NDS–84(Rev.0)) **LINTAB, HEATER and PLOTTAB code package. Computer codes for model parameters and cross-section data. (Version 87-1).** Cullen, D.E.; Smith, J.J. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Jul 1987. 90p. Order Number DE91625154. Source: OSTI; NTIS (US Sales Only); INIS.

The code LINTAB produces linearly interpolable tables of cross-sections from nuclear or atomic models. The code HEATER calculates spectrum averaged reaction rates from linearly interpolable cross-section tables. The code PLOTTAB plots and compares various data tables. These codes were prepared as a support package for atomic and molecular data, but they are also applicable to nuclear and other data. Upon request, the programs are available costfree from the IAEA Nuclear Data Section. (author).

15981 (INIS-SU–235) **Simulation of physical processes: Scientific-technical collection.** Voprosy atomnoj nauki i tekhniki. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989 119p. (In Russian). Order Number DE91003084. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers in this collection are indexed.

15982 (INIS-SU–241) **Techniques and computer codes for numerical solution of mathematical physics problems: Scientific-technical collection.** Voprosy atomnoj nauki i tekhniki. Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1988 86p. (In Russian). Order Number DE91003080. Source: OSTI; NTIS (US Sales Only); INIS.

Individual papers in this collection are indexed.

15983 (JAERI-M–90-201) **Development of the JFT-2M data analysis software system on the mainframe computer.** Matsuda, Toshiaki (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Research Establishment); Amagai, Akira; Suda, Shuji; Maemura, Katsumi; Hata, Ken-ichiro. Japan Atomic Energy Research Inst., Tokyo (Japan). Nov 1990. 30p. (In Japanese). Order Number DE91767875. Source: OSTI; NTIS (US Sales Only); INIS.

We developed software system on the FACOM mainframe computer to analyze JFT-2M experimental data archived by JFT-2M data acquisition system. Then we can reduce and distribute the CPU load of the data acquisition system. And we can analyze JFT-2M experimental data by using complicated computational code with raw data, such as equilibrium calculation and transport analysis, and useful software package like SAS statistic package on the mainframe. (author).

15984 (LA–11958-MS) **Central American information system for energy planning.** Fonseca, M.G.; Lyon, P.C.; Heskett, J.C. Los Alamos National Lab., NM (USA). Apr 1991. 78p. (In English, Spanish). Sponsored by Agency for International Development, Washington, DC (USA). DOE Contract W-7405-ENG-36. Order Number DE91010180. Source: OSTI; NTIS; GPO Dep.

SICAPE (Sistema de Information Centroamericano para Planificacion Energetica) is an expandable information system designed for energy planning. Its objective is to satisfy ongoing information requirements by means of a menu driver operational environment. SICAPE is as easily used by the novice computer user as those with more experience. Moreover, the system is capable of evolving concurrently with future requirements of the individual country. The expansion is accomplished by menu restructuring as data and user requirements change. The new menu configurations require no programming effort. The use and modification of SICAPE are separate menu-driven processes that allow for rapid data query, minimal training, and effortless continued growth. SICAPE's data is organized by country or region. Information is available in the following areas: energy balance, macro economics, electricity generation capacity, and electricity and petroleum product pricing. (JF)

15985 (LA-UR–90-4168) **Use of a genetic algorithm to analyze robust stability problems.** Murdock, T.M.; Schmitendorf, W.E.; Forrest, S. Los Alamos National Lab., NM (USA). [1990]. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910638–3: 1991 American control conference, Boston, MA (USA), 26 Jun 1991). Order Number DE91005895. Source: OSTI; NTIS; GPO Dep.

This note resents a genetic algorithm technique for testing the stability of a characteristic polynomial whose coefficients are functions of unknown but bounded parameters. This technique is fast and can handle a large number of parametric uncertainties. We also use this method to determine robust stability margins for uncertain polynomials. Several benchmark examples are included to illustrate the two uses of the algorithm. 27 refs., 4 figs.

15986 (LA-UR–91-126) **Applications of neural networks to process control and modeling.** Barnes, C.W.; Brown, S.K.; Flake, G.W.; Jones, R.D.; O'Rourke, M.K.; Lee, Y.C. Los Alamos National Lab., NM (USA). [1991]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9106117–1: International conference on artificial neural networks, Helsinki (Finland), 24-28 Jun 1991). Order Number DE91007389. Source: OSTI; NTIS; GPO Dep.

Modeling and control of physical processes are universal parts of modern life, from control of chemical plants to riding a bicycle. Often, an effective model of the process is not known so that traditional control theory is of little use. If a process can be represented by a set of a data which captures it behavior over a range of parameter settings, a neural net can inductively model the process and form the basis of an optimization procedure. We present a neural network architecture which is particularly effective in process modeling and control. We discuss its effectiveness in several application areas as well as some of the non-ideal characteristics present in real control problems which effect the form and style of the network architecture and learning algorithm. 8 refs., 6 figs.

15987 (LA-UR–91-820) **Security evaluation of the NWCNET WBCN Gateway software.** Harris, L.S.; Bailey, D.J.; Strittmatter, R.B. Los Alamos National Lab., NM (USA). [1991]. 17p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9105126–2: 14. DOE computer security group conference, Concord, CA (USA), 7-9 May 1991). Order Number DE91009943. Source: OSTI; NTIS (US Sales Only); GPO Dep.

This paper reviews the procedures and methodology associated with the security evaluation of the Nuclear Weapons Complex Network (NWCnet) WBCN Gateway software. NWCnet, built by the DOE Albuquerque Operations Office and the Computer Integrated Manufacturing Program Office, was an early attempt by the DOE to build a complex-wide network for classified data processing. The development of NWCnet broke new ground in DOE computer security management and identified several complex security issues for which new security design and planning techniques were developed. The requirement for a comprehensive security evaluation of each NWCnet service component was established by the CIM Program Office in conjunction with DOE Office of Safeguards and Security. The goals of the activity were to establish the network's overall security and to provide a technical basis on which to certify and accredit the network. In the process of designing and evaluating the WBCN Gateway software, significant knowledge was gained regarding the function of the software and the security evaluation process. Not only the did the evaluators learn how to test software in the face of continual change, but they also began to understand how to evaluate the security of a network. The function of this paper is to communicate the lessons learned from the evaluation activities. It focuses on the problems (and solutions) encountered in testing a long-term project undergoing continual, major change.

15988 (LA-UR–91-896) **Information dynamics of self-programmable matter.** Knudsen, C.; Feldberg, R.; Rasmussen, S. Los Alamos National Lab., NM (USA). [1990]. 24p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9008198–1: Complex dynamics and biological evolution conference, Middlefart (Denmark), 6-10 Aug 1990). Order Number DE91009954. Source: OSTI; NTIS; GPO Dep.

Using the simple observation that programs are identical to data, programs alter data, and thus programs alter programs, the authors have constructed a self-programming system based on a parallel von Neumann architecture. This system has the same fundamental

property as living systems have: the ability to evolve new properties. They demonstrate how this constructive dynamical system is able to develop complex cooperative structures with adaptive responses to external perturbations. The experiments with this system are discussed with special emphasis on the relation between information theoretical measures (entropy and mutual information functions) and on the emergence of complex functional properties. Decay and scaling of long-range correlations are studied by calculation of mutual information functions. 10 refs., 9 figs., 2 tabs.

15989 (LA-UR-91-903) **A neural network hybrid expert system.** Goulding, J.R. (Portland State Univ., OR (USA). Dept. of Mechanical Engineering). Los Alamos National Lab., NM (USA). [1991]. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-9103136-3: 5. national conference on undergraduate research, Pasadena, CA (USA), 21-23 Mar 1991). Order Number DE91009956. Source: OSTI; NTIS; GPO Dep.

When knowledge-based expert rules, equations, and proprietary languages extend Computer Aided Design and Computer Aided Manufacturing (CAD—CAM) software, previously designed mechanisms can be scaled to satisfy new design requirements in the shortest time. However, embedded design alternatives needed by design engineers during the product conception and rework stages are lacking, and an operator is required who has a thorough understanding of the intended design and the how-to expertise needed to create and optimize the mechanisms. By applying neural network technology to build an expert system, a robust design supervisor system emerged which automated the embedded intellectual operations (e.g. questioning, identifying, selecting, and coordinating the design process) to (1) select the best mechanisms necessary to design a power transmission gearbox from proven solutions; (2) aid the inexperienced operator in developing complex design solutions; and (3) provide design alternatives which add back-to-the-drawing board capabilities to knowledge-based mechanical CAD/CAM software programs. 15 refs., 2 figs.

15990 (LA-UR-91-992) **Simultaneous stabilization using genetic algorithms.** Benson, R.W. (California Univ., Irvine, CA (USA). Dept. of Mechanical Engineering); Schmitendorf, W.E. Los Alamos National Lab., NM (USA). [1991]. 20p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-36. (CONF-910638-4: 1991 American control conference, Boston, MA (USA), 26 Jun 1991). Order Number DE91009967. Source: OSTI; NTIS; GPO Dep.

This paper considers the problem of simultaneously stabilizing a set of plants using full state feedback. The problem is converted to a simple optimization problem which is solved by a genetic algorithm. Several examples demonstrate the utility of this method. 14 refs., 8 figs.

15991 (LUTFD2-TFRT-3206-1-75-90) **Automatic control LTH - Past, present and future.** Wittenmark, B.; Aastroem, K.J. Lund Univ. (Sweden). Dept. of Automatic Control. Feb 1990. 76p. Order Number DE91763546. Source: OSTI; NTIS (US Sales Only).

This report is a compilation of the activities at the Department of Automatic Control during the academic years 84/85-88/89. The report is written in connection with the evaluation of the Lund Institute of Technology in the spring 1990. The report contains short descriptions of different activities at the department such as personnel, funding, graduate studies, and contacts. The main part of the report is appendices giving listing of all publications of members of the department. (authors).

15992 (ORNL/TM-11786) **Modeling speedup in parallel sparse matrix factorization.** Ostrouchov, L.S. (Tennessee Univ., Knoxville, TN (USA). Dept. of Computer Science); Heath, M.T.; Romine, C.H. Oak Ridge National Lab., TN (USA). Dec 1990. 28p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OR21400. Order Number DE91010215. Source: OSTI; NTIS; GPO Dep.

This paper is an attempt to explain the observed performance of sparse matrix factorization algorithms on parallel computers. In particular, we examine whether the disappointing performance of these algorithms is due to insufficient parallelism in the problem or to the architectural characteristics of existing parallel computers. Through a series of theoretical models of increasing realism, we first determine upper and lower bounds on the speedup that can be expected in practice for this problem, and end with a parameterized model that is capable of reproducing the full range of behavior within these bounds, including the speedups actually observed in practice. This model suggests that the current limits on speedup in sparse factorization are due to poor communication performance of the present generation of parallel computer architectures rather than to a lack of parallelism in the problem. 29 refs., 11 figs., 2 tabs.

15993 (PNL-SA-19189) **Interactive image and text processing for nuclear treaty support.** Petrie, G.M.; Rohay, A.C.; Wukelic, G.E.; Foote, H.P. Pacific Northwest Lab., Richland, WA (USA). Mar 1991. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-76RL01830. (CONF-9103139-1: DOE/LLNL information management systems for nuclear test treaty verification symposium, Lake Tahoe, CA (USA), 5-7 Mar 1991). Order Number DE91009126. Source: OSTI; NTIS; INIS; GPO Dep.

The report covers experimentation with integrating a wide range of technologies and data sets with the principal goal of supporting treaty related activity. Scientists attempting to apply computer analysis tools to their problem sets often face several practical problems beyond the purely scientific ones. These include (1) the need to be proficient in several different computer operating systems with diverse characteristics, (2) the time wasted in dealing with software issues rather than problem solving and (3) the time required to master computer application software, which limits time available to explore new analysis techniques. In an attempt to mitigate these problems, the Pacific Northwest Laboratory (PNL) is developing a spatial-based data fusion system. Selected features of this system, involving advanced image and text processing schemes, have applicability to both technical and non-technical functions associated with increasing treaty-related information management requirements.

15994 (SAND-90-2231C) **Raybot: A practical implementation of a hierarchical control system for telerobotic land vehicles.** Byrne, R. Sandia National Labs., Albuquerque, NM (USA). [1990]. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. (CONF-910638-1: 1991 American control conference, Boston, MA (USA), 26 Jun 1991). Order Number DE90017029. Source: OSTI; NTIS; GPO Dep.

A hierarchical control architecture for telerobotic vehicles intended to yield a modular, flexible, and easily expanded control system is presented. This architecture is proposed for applications where simple teleoperation is required but where additional capabilities might be quickly added without major changes to the control system. Similarities to the NASREM architecture are noted. Results are given from hardware implementation of the control system on a telerobotic vehicle, Raybot, at Sandia National Laboratories.

15995 (SLAC-PUB-4561-Rev.) **Introduction to human factors: Revision.** Winter, J.M. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Mar 1991. 11p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00515. (CONF-8808317-1-Rev.: SHARE '71: Systems for heat and radiation energy human factors project, New York, NY (USA), 14-19 Aug 1988). Order Number DE91010289. Source: OSTI; NTIS; GPO Dep.

There is much to be done in Human Factors. First, I'm going to give a brief overview of the field. I'll give some background on human factors, talk about what the nature of the problem is, what the costs are, how they can be alleviated, and why we don't just run out and fix them. Second, Paul Hoffman will discuss highlights from current research and some elements of the business case. Finally, Tamara Sturak, Manager of the Human Factors Project, will talk about activities of the Project.

15996 (UCRL-ID-106621) **Travel from a supercomputer to killer micros.** Werner, N.E. Lawrence Livermore National Lab., CA (USA). Mar 1991. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91010430. Source: OSTI; NTIS; GPO Dep.

I describe my effort to convert a Fortran application that runs on a parallel supercomputer (Cray Y/MP) to run on a set of BBN

TC2000 killer micros. I used both shared memory parallel processing options available at MPCI for the BBN TC2000, the Parallel Fortran Preprocessor (PFP) and the Uniform System extended Fortran compiler (US). I describe how I used the BBN Xtra programming tools for analysis and debugging during this conversion process. My ultimate goal for this hands on experiment was to gain insight into the type of tools that might be helpful for porting existing programs from a supercomputer environment to a killer micro environment. 5 refs., 9 figs.

15997 (UCRL-ID–106965) **Report of the ERSUG Charging and Scheduling Algorithms Working Group.** Bathke, C.; Anderson, D.; Jette, M.; Mirin, A.; Potter, G. Lawrence Livermore National Lab., CA (USA). 28 Mar 1991. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. Order Number DE91010907. Source: OSTI; NTIS; GPO Dep.

The Charging and Scheduling Algorithms Working Group of ERSUG was formed in February 1990 in response to a request from Tom Kitchens and Ralph Lewis. This request came about because of complaints to the effect that interactive jobs were obtaining slow system response, large production jobs were getting poor turnaround, and large codes were being assessed too high a memory charge. The Group was asked to take a fresh look at the charging and scheduling algorithms at NERSC and to recommend how jobs experiencing difficulty executing could be accommodated.

15998 (UCRL-JC–104036) **Sisal City and Xcbi: Reference manual: Version 1.0.** Uejio, J.Y. Lawrence Livermore National Lab., CA (USA). May 1990. 29p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9006328–1: Asilomar conference on circuits, systems, and computers, Pacific Grove, CA (USA), 5-8 Jun 1990). Order Number DE91009751. Source: OSTI; NTIS; GPO Dep.

This manual describes Sisal City, the programming environment for Sisal, and xcbi, the X window based configurable user interface. Sisal City is designed to support X window based on non-X window based (command line) programming tools. The command line tools, such as compilers and debuggers, are intergrated into Sisal City by an external user interface called xcbi, X Configurable Button Interface. Xcbi provides a button, command line, and pull-down menu user interface; inter-process communications; and a pseudo tty to connect to the command line based UNIX program. This manual is written for programmers wishing to add tools to Sisal City. The first chapter discusses briefly how to use Sisal City. The next sections describe the features and commands of xcbi and describe how to create new user interfaces.

15999 (UCRL-JC–105185) **Shapes and textures for rendering coral.** Max, N.L. (Lawrence Livermore National Lab., CA (USA)); Wyvill, G. Lawrence Livermore National Lab., CA (USA). 18 Oct 1990. 13p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9106115–1: CG international conference, Cambridge, MA (USA), 27-29 Jun 1991). Order Number DE91007123. Source: OSTI; NTIS; GPO Dep.

A growth algorithm has been developed to build coral shapes out of a tree of spheres. A volume density defined by the spheres is contoured to give a "soft object." The resulting contour surfaces are rendered by ray tracing, using a generalized volume texture to produce shading and "bump mapped" normal perturbations. 16 refs., 8 figs.

16000 (UCRL-JC–105515) **Using the graphical kernel system in scientific computing.** Fong, Kirby W. Lawrence Livermore National Lab., CA (USA). 25 Jan 1991. 5p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9104173–2: NCGA '91 conference and exposition, Chicago, IL (USA), 22-25 Apr 1991). Order Number DE91010462. Source: OSTI; NTIS; GPO Dep.

The Graphical Kernel System (GKS) originated as an application interface to two dimensional graphics when it first became an international and US standard in the 1980's. The National Energy Research Supercomputer Center (NERSC) of the Lawrence Livermore National Laboratory provides supercomputing services including graphical output to scientists and engineers performing research for the US Department of Energy's Office of Energy Research. NERSC adopted GKS and has been using it successfully for some of its graphics applications. This article reviews the context in which GKS is effective.

16001 (UCRL-JC–106647) **Scientific visualization software for your PC: Free and available now!.** Greenly, G.D. Jr. Lawrence Livermore National Lab., CA (USA). Mar 1991. 19p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-910659–11: 84. annual meeting and exhibition of the Air and Waste Management Association (AWMA), Vancouver (Canada), 16-21 Jun 1991). Order Number DE91010156. Source: OSTI; NTIS; GPO Dep.

Super computers provide todays scientist the compute power to easily handle very large numerical models. The National Center for Supercomputing Applications (NCSA), at the University of Illinois at Urbana-Champaign, has developed a suite of new public domain software for the visualization of scientific data on personal computers (PC). Hierarchical Data Format (HDF), a flexible file format, designed at NCSA for sharing 2-D graphical and floating point data arrays among different programs and machines, is the core capability of this free software. HDF allows the researcher to store raster images, their dimensions, color tables, annotations, and units of measure all in the same file. HDF output files can be viewed on a PC using this suite of software applications. This paper discusses the NCSA software, how it can be used with the Mackintosh II family of computers, with their superior color graphics capability, and how the software can be obtained free of charge. Information regarding use of the software with other PCs and workstations is also presented. 7 refs., 17 figs.

16002 (WHC-SA–1006) **Use of personal computers in performing a linear modal analysis of a large finite-element model.** Wagenblast, G.R.; Northey, M.D. Westinghouse Hanford Co., Richland, WA (USA). Mar 1991. 8p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC06-87RL10930. (CONF-910602–23: American Society of Mechanical Engineers (ASME) pressure vessels and piping conference, San Diego, CA (USA), 23-27 Jun 1991). Order Number DE91010112. Source: OSTI; NTIS; GPO Dep.

This paper presents the use of personal computers in performing a dynamic frequency analysis of a large (2801 degrees of freedom) finite-element model. Large model linear time history dynamic evaluations of safety related structures were previously restricted to mainframe computers using direct integration analysis methods. This restriction was a result of the limited memory and speed of personal computers. With the advances in memory capacity and speed of the personal computers, large finite-element problems now can be solved in the office in a timely and cost effective manner. Presented in three sections, this paper describes the procedure used to perform the dynamic frequency analysis of the large (2801 degrees of freedom) finite-element model on a personal computer. Section 2.0 describes the structure and the finite-element model that was developed to represent the structure for use in the dynamic evaluation. Section 3.0 addresses the hardware and software used to perform the evaluation and the optimization of the hardware and software operating configuration to minimize the time required to perform the analysis. Section 4.0 explains the analysis techniques used to reduce the problem to a size compatible with the hardware and software memory capacity and configuration.

9903 Information Handling

Refer also to citation(s) 14342, 14705, 15228, 15489, 15650, 15655, 15656, 15657, 15658, 15659, 15660, 15661, 15662, 15663, 15664, 15665, 15666, 15677, 15694, 15703, 15704, 15707, 15724, 15766, 15767, 15782, 15958, 15976, 15977, 15980, 15993

16003 (IAEA-NDS–0(Rev.90/9)) **Index to the IAEA-NDS-Documentation Series.** Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1990. 17p. Order Number DE91625142. Source: OSTI; NTIS (US Sales Only); INIS.

This index lists the current versions of the IAEA-NDS-documents which summarize contents and formats of nuclear data libraries available from the IAEA Nuclear Data Section. (author).

16004 (IAEA-NDS–1(Rev.5)) **Short guide to EXFOR.** Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Jun 1986. 24p. Order Number DE91625127. Source: OSTI; NTIS (US Sales Only); INIS.

EXFOR is a computerized system for the storage, retrieval and international exchange of experimental nuclear reaction data induced by neutrons, photons, charged particles and heavy ions. The data file in an agreed "EXchange FORmat" is produced and maintained by a network of national and regional nuclear data centers. The present document gives an introduction to EXFOR and describes the products available from the IAEA Nuclear Data Section. Data retrievals in different output formats are available costfree upon request. (author).

16005 (IAEA-NDS–29(Rev.2)) **ENDF utility codes version 6.4 for ENDF-5 and ENDF-6: Description and operating instructions.** McLaughlin, P.K. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1988. 40p. Order Number DE91625135. Source: OSTI; NTIS (US Sales Only); INIS.

Description and operating instructions are given for a package of utility codes operating on evaluated nuclear data files in the formats ENDF-5 and ENDF-6. Included are the data checking codes CHECKER, FIZCON, PSYCHE; the code INTER for retrieving thermal cross-sections and some other data; graphical plotting codes PLOTEF, GRABLIB, VERSAT; and the file maintenance and retrieval codes LISTEF, SETMDC, GETMAT, STANEF. This program package can be obtained on magnetic tape or floppy diskette, free of charge, from the IAEA Nuclear Data Section. (author).

16006 (IAEA-NDS–65(Rev.0)) **ENDF/B-5 modifications 1986.** McLaughlin, P.K. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. May 1986. 223p. Order Number DE91625136. Source: OSTI; NTIS (US Sales Only); INIS.

This document summarizes the modifications made to the ENDF/B-5 evaluated neutron data files in 1986. The new versions of the files are available from the IAEA Nuclear Data Section upon request, costfree, on magnetic tape. (author).

16007 (IAEA-NDS–69(Rev.0)) **ENDF/B Pre-Processing Codes: Implementing and testing on a Personal Computer.** McLaughlin, P.K. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. May 1987. 33p. Order Number DE91625137. Source: OSTI; NTIS (US Sales Only); INIS.

This document describes the contents of the diskettes containing the ENDF/B Pre-Processing codes by D.E. Cullen, and example data for use in implementing and testing these codes on a Personal Computer of the type IBM-PC/AT. Upon request the codes are available from the IAEA Nuclear Data Section, free of charge, on a series of 7 diskettes. (author).

16008 (IAEA-NDS–70(Rev.0)) **ENDFIS86/8. Index to the major evaluated neutron data libraries available from the IAEA Nuclear Data Section.** McLaughlin, P.K. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Aug 1986. 89p. Order Number DE91625138. Source: OSTI; NTIS (US Sales Only); INIS.

The major evaluated neutron data libraries in the formats of ENDF/B, UKNDL or KEDAK are indexed by element and isotope. Upon request, all data libraries or selective retrievals from them are available, costfree, from the IAEA Nuclear Data Section. (author).

16009 (IAEA-NDS–76(Rev.3)) **ENDF-6 Formats Manual: Version of July 1990.** Rose, P.F. (National Nuclear Data Center, Upton, NY (USA)); Dunford, C.L. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Jul 1990. 3p. Order Number DE91625139. Source: OSTI; NTIS (US Sales Only); INIS.

ENDF-6 is the international computer file format for evaluated nuclear data. In contrast to the earlier versions (ENDF-4 ENDF-5) the new version ENDF-6 has been designed not only for neutron reaction data but also for photo-nuclear and charged-particle nuclear reaction data. This document gives a detailed description of the formats and procedures adopted for ENDF-6. (author).

16010 (IAEA-NDS–78(Rev.0)) **Codes CONV45 and CONV56 for a PC.** Rose, P.F. (Brookhaven National Lab., Upton, NY (USA)). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Mar 1988. 12p. Order Number DE91625140. Source: OSTI; NTIS (US Sales Only); INIS.

Implemented on PC by V. Goulo.

The codes CONV45 and CONV56 convert data files from ENDF/B-4 to ENDF/B-5 and from ENDF/B-5 to ENDF/B-6 format respectively. The codes which were received from US National Nuclear Data Center were implemented at the IAEA Nuclear Data Section for use on personal computers. (author). 2 refs, 3 tabs.

16011 (IAEA-NDS–85(Rev.0)) **Implementing and Testing the LINTAB, HEATER and PLOTTAB code package.** Cullen, D.E.; Smith, J.J. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Jul 1987. 4p. Order Number DE91625141. Source: OSTI; NTIS (US Sales Only); INIS.

Enclosed is a description of the magnetic tape or floppy diskette containing the LINTAB, HEATER and PLOTTAB code package. In addition detailed information is provided on implementation and testing of these codes. These codes are documented in IAEA-NDS-84. (author).

16012 (IAEA-NDS–100(Rev.3)) **ENDF/B-6. The U.S. Evaluated Nuclear Data Library for Neutron Reaction Data: Summary of contents.** Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1990. 25p. Order Number DE91625128. Source: OSTI; NTIS (US Sales Only); INIS.

This document summarizes the contents of the general-purpose neutron data file on ENDF/B-6, the U.S. Evaluated Nuclear Data Library. The entire library or retrievals of selected materials are available on magnetic tape from the IAEA Nuclear Data Section free of charge. (author).

16013 (IAEA-NDS–103(Rev.89/1)) **EXFOR Manual. Center-to-Center Exchange Format. Version 89-1.** McLane, V. (Brookhaven National Lab., Upton NY (USA). National Nuclear Data Center). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1989. 287p. Order Number DE91626179. Source: OSTI; NTIS (US Sales Only); INIS.

EXFOR is the agreed exchange format for the transmission of nuclear reaction data between national and international nuclear data centers for the benefit of nuclear data users in all countries. EXFOR is a database with several million data records containing the world's experimental nuclear reaction data induced by neutrons, photons or charged particles. Data retrievals can be obtained from the IAEA Nuclear Data Section (NDS) or from one of the co-operating data centers whose names and addresses can be found inside the manual. Their contributions and co-operative efforts are gratefully acknowledged. (author). Refs.

16014 (IAEA-NDS–107(Rev.4)) **Index to BROND, ENDF/B-6, JEF-1, JENDL-3.** Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1990. 13p. Order Number DE91625129. Source: OSTI; NTIS (US Sales Only); INIS.

This document contains a brief index to the three main data libraries for evaluated neutron reaction data, including BROND from USSR, ENDF/B-6 from USA, JEF-1 from OECD/NEA and JENDL-3 from Japan. (author).

16015 (IAEA-NDS–109(Rev.90/2)) **CINDA Manual: Maintained by the NEA Data Bank on behalf of the co-operating Nuclear Reaction Data Centers.** Webster, S. (ed.). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Feb 1990. 86p. Order Number DE91625130. Source: OSTI; NTIS (US Sales Only); INIS.

CINDA is a computerized index to the literature and numeric data files of microscopic neutron cross-sections and related data such as angular distributions, resonance parameters, fission-product data, etc. Retrievals from the CINDA file are available from the IAEA Nuclear Data Section or from the co-operating Nuclear Reaction Data Centers. CINDA books are regularly published by IAEA. This document contains the rules to be observed by the CINDA indexers when preparing the CINDA input. (author).

16016 (IAEA-NDS–110(Rev.2)) **JENDL-3. The Japanese Evaluated Nuclear Data Library: Summary of contents.** Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria).

Nuclear Data Section. Oct 1990. 20p. Order Number DE91625131. Source: OSTI; NTIS (US Sales Only); INIS.

This document summarizes the contents of JENDL-3, the Japanese evaluated data library for neutron nuclear data, released in 1989. The entire library or retrievals of selected materials are available on magnetic tape from the IAEA Nuclear Data Section free of charge. (author). 2 tabs.

16017 (IAEA-NDS–113(Rev.0)) **ENDF/B-6 High-Energy Data File: Summary.** Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Mar 1990. 1p. Order Number DE91625132. Source: OSTI; NTIS (US Sales Only); INIS.

This document summarizes the high-energy subfile of ENDF/B-6, the U.S. Evaluated Nuclear Data Library. At present it contains neutron and proton reaction data up to 1 GeV for 26-Fe-56. The file is available on magnetic tape or on diskette from the IAEA Nuclear Data Section free of charge. (author).

16018 (IAEA-NDS–119(Rev.0)) **NJOY. A comprehensive system for the processing of ENDF formatted nuclear data.** Muir, D.W. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Jul 1990. 8p. Order Number DE91625133. Source: OSTI; NTIS (US Sales Only); INIS.

An introduction to the program system NJOY is given which processes data files of evaluated neutron nuclear data coded in ENDF format. NJOY is primarily used for neutron and photon transport calculations for nuclear power reactor design. The NJOY code is not available from the IAEA Nuclear Data Section but may be obtained from the Reactor Shielding Information Center, Oak Ridge, USA. (author). 10 refs, 1 fig.

16019 (IAEA-NDS–122(Rev.0)) **JEF-1 Radioactive Decay Data: Brief summary of contents.** Lemmel, H.D. International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section. Sep 1990. 1p. Order Number DE91625134. Source: OSTI; NTIS (US Sales Only); INIS.

This document gives a brief documentation of the JEF-1 Radioactive Decay Data library which is available from the IAEA Nuclear Data Section on magnetic tape, free of charge. (author).

16020 (INIS-SU–234, pp. 78-79) **Representation of the BAS constant system in the ENDL format.** Cherepanova, E.I.; Shmakov, V.M. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1989. 82p. (In Russian). In *Simulation of physical processes: Scientific-technical collection.* Order Number DE91003090. Source: OSTI; NTIS (US Sales Only); INIS.

Data representation from the PROM library in the ENDL format described. New types of data in comparison with the official ENDL format characterizing the multiplying properties of elements and the total kinetic energy release are introduced. A new description of energy distribution of secondary particles as two-dimensional tables with equiprobable representation of intermediate tables is introduced. 5 refs.; 1 tab.

16021 (JAERI-M–90-218) **Information retrieval system of nuclear power plant database (PPD) user's guide.** Izumi, Fumio (Nuclear Energy Data Center, Tokai, Ibaraki (Japan)); Horikami, Kunihiko; Kobayashi, Kensuke. Japan Atomic Energy Research Inst., Tokyo (Japan). Dec 1990. 73p. (In Japanese). Order Number DE91767905. Source: OSTI; NTIS (US Sales Only); INIS.

A nuclear power plant database (PPD) and its retrieval system have been developed. The database involves a large number of safety design data of nuclear power plants, operating and planned in Japan. The information stored in the database can be retrieved at high speed, whenever they are needed, by use of the retrieval system. The report is a user's manual of the system to access the database utilizing a display unit of the JAERI computer network system. (author).

16022 (K/CSD/TM–97) **Active Design Database (ADDB) user's manual.** Schwarz, R.L.; Nations, J.A. (eds.); Rosser, J.H. Oak Ridge K-25 Site, TN (USA). Feb 1991. 27p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OT21400. Order Number DE91010431. Source: OSTI; NTIS; GPO Dep.

This manual is a guide to the Active Design Database (ADDB) on the Martin Marietta Energy Systems, Inc., IBM 3084 unclassified computer. The ADDB is an index to all CADAM models in the unclassified CADAM database and provides query and report capabilities. Section 2.0 of this manual presents an overview of the ADDB, describing the system's purpose; the functions it performs; hardware, software, and security requirements; and help and error functions. Section 3.0 describes how to access the system and how to operate the system functions using Database 2 (DB2), Time Sharing Option (TSO), and Interactive System Productivity Facility (ISPF) features employed by this system. Appendix A contains a dictionary of data elements maintained by the system. The data values are collected from the unclassified CADAM database. Appendix B provides a printout of the system help and error screens.

16023 (K/DSRD–461) **Security aspects of database management systems.** Hicks, S.E.; Evans, K.C. Oak Ridge K-25 Site, TN (USA). 8 Mar 1991. 122p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC05-84OT21400. Order Number DE91010677. Source: OSTI; NTIS (US Sales Only); GPO Dep.

Research and development in the area of database management technology began in the 1960s. From this work, the first commercially available data base management system (DBMS) were introduced. These initial DBMSs used the hierarchical and networked data models discussed in section 1.1.1.5.2 and 1.1.1.5.3. of this report. During the 1970s, research focused on the relational data model. Section 1.1.1.5.1 describes this model. Relational database management systems became commercially available in the early 1980s and remain the most widely used type of DBMS today. Emerging research is taking advantage of advances in artificial intelligence and programming languages. One result has been the advent of the object-oriented data model, discussed in section 1.1.1.5.4. Due to the extensive dependence on database management systems by the majority of society, data security has become a growing concern. The purpose of this report is to provide an information baseline for the Department of Energy (DOE) on the current DBMS security technology. The document begins with an overview of DBMS use and architectures, followed by a summary of security concepts. The remaining sections discuss DBMS security issues, research and vendor efforts, standards activities, and DOE DBMS security needs. Because the vast majority of database security research in focused on relational DBMSs, the discussions in this report focus on the relational database model.

16024 (SAND–90-2513) **HEART handbook for guest editors.** Vittitoe, C.N. Sandia National Labs., Albuquerque, NM (USA). Feb 1991. 42p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC04-76DP00789. Order Number DE91009727. Source: OSTI; NTIS; GPO Dep.

This handbook outlines the basic job of guest editors for the HEART Conference proceedings, published by the DoD Nuclear Information and Analysis Center in the Journal of Radiation Effects, Research and Engineering. Suggestions are offered for procedures to aid the editors, authors, reviewers, and the publisher in assuring that the journal communicates clearly, concisely, and honestly.

16025 (SLAC-PUB–5450) **The Cheetah Data Management System.** Kunz, P.F. (Stanford Linear Accelerator Center, Menlo Park, CA (USA)); Word, G.B. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Mar 1991. 7p. Sponsored by USDOE, Washington, DC (USA). DOE Contract AC03-76SF00515. (CONF-9011192–1: 14. Italian National Institute of Nuclear Physics (INFN) workshop: data structures for particle physics experiments, Erice (Italy), 11-18 Nov 1990). Order Number DE91010290. Source: OSTI; NTIS; GPO Dep.

Cheetah is a data management system based on the C programming language. The premise of Cheetah is that the 'banks' of FORTRAN based systems should be 'structures' as defined by the C language. Cheetah is a system to mange these structures, while preserving the use of the C language in its native form. For C structures managed by Cheetah, the user can use Cheetah utilities such as reading and writing, in a machine independent form, both binary and text files to disk or over a network. Files written by Cheetah also contain a dictionary describing in detail the data contained in

the file. Such information is intended to be used by interactive programs for presenting the contents of the file. Such information is intended to be used by interactive programs for presenting the contents of file. Cheetah has been ported to many different operating systems with no operating system dependent switches.

16026 (UCRL-JC–105865) **The intelligent database: Using INGRES to manage the external analysis of your data.** Dougan, A.D.; Willes, E.H. Jr.; Buckley, W.M.; Delucchi, A.; Manatt, D.R. Lawrence Livermore National Lab., CA (USA). 6 Mar 1991. 12p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9105160–1: North America INGRES Users Association annual (NAIUA) meeting, San Jose, CA (USA), 19-23 May 1991). Order Number DE91010465. Source: OSTI; NTIS; GPO Dep.

We have developed an application that uses a database to store the methods and rules for our analysis. Our rules are in the form of equations that are generated by a user and subject to frequent editing. We send the equations to a spreadsheet for calculation. When the results are defined as "best," the answers are sent back to the database for storage. Our ad hoc methodology is thus stored with the input data and results for better quality assurance and documentation. 2 refs., 6 figs.

16027 (UCRL-JC–106617) **Applications: Still the DBA's security blanket.** Buckley, W.M. Lawrence Livermore National Lab., CA (USA). 6 Mar 1991. 10p. Sponsored by USDOE, Washington, DC (USA). DOE Contract W-7405-ENG-48. (CONF-9105160–2: North America INGRES Users Association annual (NAIUA) meeting, San Jose, CA (USA), 19-23 May 1991). Order Number DE91010473. Source: OSTI; NTIS; GPO Dep.

With Release 6.3 of INGRES, several new capabilities were added which are of interest to the DBA who wishes to control and restrict access to the database. These are groups, roles, rules and resource controls. There are aspects to each of these capabilities that suggest that applications are still the most effective means for assuring the security of data in INGRES tables. Casual usage of these new INGRES features could leave the DBA in situations of wondering "What happened and who did it?" In some cases, INGRES will ignore the controls placed with these mechanisms. This paper will discuss caveats for usage of these new features. A wish list of related improvements will be presented as a conclusion. Security here is defined as the protection against unauthorized or accidental modification, deletion, access or denial of data. 8 refs., 1 fig., 1 tab.

9904 Law

16028 (IAEA-INFCIRC–9(Rev.2/Add.8)) **Agreement on the privileges and immunities of the Agency: Acceptances by Member States.** International Atomic Energy Agency, Vienna (Austria). Jan 1991. 12p. Order Number DE91625126. Source: OSTI; NTIS (US Sales Only); INIS.

Hard copies are available in various languages from IAEA Division of Publication, Distribution Unit.

The document lists the 61 Member States which by 1 January 1991, have accepted the Agreement on the Privileges and Immunities of the International Atomic Energy Agency as provided for in Section 38 thereof. This list is followed by the texts of reservations made to the Agreement.

16029 (IAEA-INFCIRC–385(Add.1)) **Communication received from the Federal Republic of Germany.** International Atomic Energy Agency, Vienna (Austria). Feb 1991. 2p. Order Number DE91625118. Source: OSTI; NTIS (US Sales Only); INIS.

The document reproduces the text of the Note (dated 4 October 1990), received by the Secretariat of the IAEA from the Permanent Mission of the Federal Republic of Germany regarding continued application of treaties of the Federal Republic of Germany and the status of the treaties of the German Democratic Republic following its accession to the Federal Republic of Germany with effect from 3 October 1990.

16030 (IAEA-TECDOC–589) **Analysis of replies to an IAEA questionnaire on inspection and enforcement by the regulatory body for nuclear power plants.** International Atomic Energy Agency, Vienna (Austria). Mar 1991. 67p. Order Number DE91626176. Source: OSTI; NTIS (US Sales Only); INIS.

At a Special Session of the IAEA General Conference in September 1986. it was suggested that the IAEA could play a role in assisting Member States in the enhancement of their regulatory practices with the objective of increasing the confidence of the international community in the safety of nuclear power programmes. As the first stage of this assistance, the Agency initiated an IAEA Questionnaire on Regulatory Practices in Member States with Nuclear Power Programmes and summarized the results of an analysis of replies to the questionnaire, issued as IAEA-TECDOC–485 (October 1988). The IAEA Questionnaire on Inspection and Enforcement by the Regulatory Body for Nuclear Power Plants, drafted by a group of consultants and IAEA staff members in August 1989, was initiated as a follow-up to the general questionnaire on regulatory practices. This questionnaire on inspection and enforcement was sent on 3 October 1989 to 31 Member States in which nuclear power plants are under construction and/or in operation. Replies to the questionnaire received from 26 Member States were analysed by IAEA staff members with the assistance of consultants in order to identify the main differences in approach and important aspects of inspection and enforcement by the regulatory body for nuclear power plants. This report is the summary report on the results of the analysis of the replies to the questionnaire from 26 Member States. 12 tabs.

16031 (INIS-mf–12806, pp. 367-370) **International cooperation in nuclear energy.** Blix, H. (International Atomic Energy Agency, Vienna (Austria)). Canadian Nuclear Association, Toronto, ON (Canada). 1983. 388p. (CONF-830934–: 4. Pacific Basin nuclear conference, Vancouver (Canada), 11-15 Sep 1983). In *Proceedings of the fourth Pacific Basin nuclear conference.* Order Number DE91626129. Source: OSTI; NTIS (US Sales Only); INIS.

In the field of nuclear energy, much useful international cooperation is underway and much more could be undertaken. International cooperation is essential if nuclear power is to continue to expand and to reach its full potential. The author reviews progress the IAEA has made in promoting cooperation in the areas of safeguards, information management, nuclear trade, safety, codes of practice, exchange of operating experience, response to nuclear accidents, transportation of radioactive materials, waste management, research, aid for developing countries, and non-proliferation.

Corporate Author Index

This index lists the corporate authors responsible for issuing the documents in this publication which are identified primarily by report number. The corporate names are entered in standardized forms as defined in *DOE Energy Data Base: Corporate Author Entries* (DOE/TIC-4585). Each entry under a corporate name includes the document title and citation number. Three items of information may appear in parentheses: (1) an abbreviation to identify the document type, such as a report; (2) the country of publication, also abbreviated; and (3) the language of the document if non-English (R;US;In French). Author affiliations are not listed in this index.

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	EG and G Energy Measurements, Inc., Las Vegas, NV (USA). Remote Sensing Lab.	
	16:15226	EGG–10617-1079
AC08-89NV10630	**Reynolds Electrical and Engineering Co., Inc., Las Vegas, NV (USA)**	
	16:15270	DOE/NV/10630–12
AC08-89NV10733	**Blume (John A.) and Associates Research Div., San Francisco, CA (USA)**	
	16:15444	JAB–10733-TM3
AC08-90NV10845	**Nevada Univ., Reno, NV (USA). Desert Research Inst.**	
	16:15294	DOE/NV/10845–7
AC09-76SR00001	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.**	
	16:14625	DPST–83-718-Rev.1
	16:14626	DPST–86-802
	16:15296	DPST–88-605
	Savannah River Lab., Aiken, SC (USA)	
	16:14258	DP-MS–86-217-AI-All
	16:14624	DPST–67-285
AC09-89SR18035	**Du Pont de Nemours (E.I.) and Co., Aiken, SC (USA). Savannah River Lab.**	
	16:14625	DPST–83-718-Rev.1
	16:14626	DPST–86-802
	16:15296	DPST–88-605
	Savannah River Lab., Aiken, SC (USA)	
	16:14258	DP-MS–86-217-AI-All
	16:14624	DPST–67-285

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	Westinghouse Savannah River Co., Aiken, SC (USA)	
	16:14319	WSRC-MS-90-266
	16:14326	WSRC-IM-90-60-Vol.1
	16:14327	WSRC-IM-90-60-Vol.2
	16:14347	WSRC-MS-90-225
	16:14582	WSRC-MS-91-026
	16:14590	WSRC-MS-90-192
	16:14651	WSRC-MS-90-20
	16:14652	WSRC-MS-90-205
	16:14653	WSRC-RP-89-820
	16:15295	DOE/SR/18035-P-H2
	16:15308	NMP-RMT-900326
AC12-76SN00052	**Knolls Atomic Power Lab., Schenectady, NY (USA)**	
	16:14576	KAPL-4723
	16:15778	KAPL-4721
	16:15779	KAPL-4724
AC21-83MC20037	**Alaska Univ., Fairbanks, AK (USA). Geophysical Inst.**	
	16:14051	DOE/MC/20037-2939
AC21-86MC23075	**Advanced Fuel Research, Inc., East Hartford, CT (USA)**	
	16:13984	DOE/MC/23075-2973
	16:13985	DOE/MC/23075-2974
AC21-86MC23263	**Minnesota Univ., Minneapolis, MN (USA). Corrosion Research Center**	
	16:14752	DOE/MC/23263-2877
AC21-87MC23270	**International Fuel Cells Corp., South Windsor, CT (USA)**	
	16:14753	DOE/MC/23270-2969
AC21-87MC24266	**Institute of Gas Technology, Chicago, IL (USA)**	
	16:13948	DOE/MC/24266-2966
	16:13983	DOE/MC/24266-2978
AC21-89MC26367	**Manufacturing and Technology Conversion International, Inc., Columbia, MD (USA)**	
	16:13949	DOE/MC/26367-2958
AC22-84PC70512	**Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center**	
	16:15928	DOE/ET/51013-T238
AC22-86PC90013	**Union Carbide Chemicals and Plastics Co., Inc., South Charleston, WV (USA). Solvents and Coatings Materials Div.**	
	16:13970	DOE/PC/90013-T14
AC22-86PC91257	**TRW, Inc., Redondo Beach, CA (USA). Applied Technology Div.**	
	16:13975	DOE/PC/91257-T7
AC22-87PC79876	**ARCTECH, Inc., Alexandria, VA (USA)**	
	16:13954	DOE/PC/79876-T1
AC22-87PC79880	**OTISCA Industries Ltd., Syracuse, NY (USA)**	
	16:13935	DOE/PC/79880-T2
	16:13936	DOE/PC/79880-T3
	16:14017	DOE/PC/79880-T1
	16:14018	DOE/PC/79880-T4
	16:14019	DOE/PC/79880-T5
	16:14020	DOE/PC/79880-T6
	16:14021	DOE/PC/79880-T7
AC22-87PC90274	**TRW Space and Technology Group, Redondo Beach, CA (USA). Applied Technology Div.**	
	16:14749	DOE/PC/90274-T9
	16:14750	DOE/PC/90274-T10
AC22-88PC88800	**Consolidation Coal Co., Library, PA (USA)**	
	16:13986	DOE/PC/88800-34
AC22-88PC88812	**Colorado School of Mines, Golden, CO (USA). Dept. of Chemical Engineering and Petroleum Refining**	
	16:13955	DOE/PC/88812-T7
AC22-88PC88850	**CHAM of North America, Inc., Huntsville, AL (USA)**	
	16:14494	DOE/PC/88850-T2
AC22-88PC88874	**Acurex Corp., Research Triangle Park, NC (USA). Environmental Systems Div.**	
	16:13997	DOE/PC/88874-T12
AC22-88PC88883	**Battelle, Columbus, OH (USA)**	
	16:13937	DOE/PC/88883-T8
AC22-88PC88891	**Institute of Gas Technology, Chicago, IL (USA)**	
	16:13956	DOE/PC/88891-T4
AC22-88PC88947	**Cornell Univ., Ithaca, NY (USA)**	
	16:14022	DOE/PC/88947-T9
AC22-89PC88885	**Coal Technology Corp., Bristol, VA (USA)**	
	16:13938	DOE/PC/88885-T2
AC22-89PC88889	**MK-Ferguson Co., Cleveland, OH (USA)**	
	16:14495	DOE/PC/88889-T7
AC22-89PC89807	**Cottrell Environmental Sciences, Somerville, NJ (USA)**	
	16:13999	DOE/PC/89807-T2
AC22-89PC89867	**Bechtel Group, Inc., San Francisco, CA (USA)**	
	16:13967	DOE/PC/89867-T2
AC22-89PC89903	**Lehigh Univ., Bethlehem, PA (USA). Dept. of Biology**	
	16:13968	DOE/PC/89903-T2
	16:13969	DOE/PC/89903-T3
AC22-89PC89908	**Aspen Technology, Inc., Cambridge, MA (USA)**	
	16:13939	DOE/PC/89908-T6
AC22-89PC89909	**Virginia Polytechnic Inst. and State Univ., Blacksburg, VA (USA). Virginia Center for Coal and Energy Research**	
	16:13940	DOE/PC/89909-T4
AC22-90PC90037	**IIT Research Inst., Chicago, IL (USA)**	
	16:13971	DOE/PC/90037-T2
	16:13972	DOE/PC/90037-T3
AC22-90PC90177	**Coal Technology Corp., Bristol, VA (USA)**	
	16:13941	DOE/PC/90177-T1
AC22-90PC90178	**Utah Univ., Salt Lake City, UT (USA)**	
	16:13942	DOE/PC/90178-T1
AC34-90DP62349	**EG and G Rocky Flats, Inc., Golden, CO (USA)**	
	16:15439	RFP-4348
AC79-85BP23821	**Washington State Energy Office, Olympia, WA (USA)**	
	16:14790	DOE/BP/23821-5
	16:14791	DOE/BP/23821-6
AC79-87BP35544	**IIT Research Inst., Chicago, IL (USA)**	
	16:14792	DOE/BP/35544-1
AI01-85CE40748	**National Inst. of Standards and Technology, Washington, DC (USA). Center for Chemical Engineering**	
	16:14840	DOE/CE/40748-T1
AI01-86CE50162	**Case Western Reserve Univ., Cleveland, OH (USA)**	
	16:14843	DOE/NASA/50162-5
AI79-84BP16475	**Forest Service, WY (USA). Nez Perce National Forest**	
	16:14403	DOE/BP/16475-1
AI79-84BP17579	**Forest Service, Ogden, UT (USA). Intermountain Region**	
	16:15290	DOE/BP/17579-2
AI79-86BP60294	**USDOE Bonneville Power Administration, Portland, OR (USA)**	
	16:14793	DOE/BP/60294-1
AI79-86BP64321	**Forest Service, Salmon, ID (USA). Salmon National Forest**	
	16:14404	DOE/BP/64321-2

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AI79-87BP35245		Fish and Wildlife Service, Seattle, WA (USA). Seattle National Fishery Research Center
	16:15335	DOE/BP/35245–3
AI79-90BP07096		USDOE Bonneville Power Administration, Portland, OR (USA). Div. of Fish and Wildlife
	16:15332	DOE/BP/07096–1
AS03-88DP10754		Wisconsin Univ., Madison, WI (USA). Fusion Technology Inst.
	16:15955	UWFDM–850
AS05-76ER03956		Oak Ridge National Lab., TN (USA). Center for Computationally Intensive Physics
	16:15830	ORNL/CCIP–91/03
AS05-89ER40523		Mississippi Univ., University, MS (USA). Dept. of Physics and Astronomy
	16:15536	DOE/ER/40523–T3
AS06-88ER40423		Washington Univ., Seattle, WA (USA). Dept. of Physics
	16:15459	DOE/ER/40423–06-P90
	16:15460	DOE/ER/40423–19
	16:15573	DOE/ER/40423–13-P90
AT01-76ET10813		Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center
	16:15928	DOE/ET/51013–T238
BI79-84BP14383		USDOE Bonneville Power Administration, Portland, OR (USA). Div. of Fish and Wildlife
	16:15289	DOE/BP/14383–4
BI79-85BP24332		Oregon State Univ., Corvallis, OR (USA). Dept. of Electrical and Computer Engineering
	16:14405	DOE/BP/24332–1
BI79-86BP64344		USDOE Bonneville Power Administration, Portland, OR (USA). Div. of Fish and Wildlife
	16:15291	DOE/BP/64344–2
BI79-88BP39339		USDOE Bonneville Power Administration, Portland, OR (USA). Div. of Fish and Wildlife
	16:15333	DOE/BP/39339–3
FC02-89CH10402		Council of State Governments, Lombard, IL (USA). Midwestern Office
	16:14245	DOE/CH/10402–8
FC03-85DP40200		Syracuse Univ., NY (USA). Dept. of Physics
	16:15925	DOE/ER/18862–1
		Rochester Univ., NY (USA). Lab. for Laser Energetics
	16:15924	DOE/DP/40200–149-Vol.45
FC07-88ID12726		EG and G Idaho, Inc., Idaho Falls, ID (USA)
	16:15229	EGG-M–90553
FC07-89ID12826		TECOGEN, Inc., Waltham, MA (USA)
	16:14841	DOE/ID/12826–1
FC07-89ID12882		Pulse Sciences, Inc., Agoura Hills, CA (USA)
	16:14842	DOE/ID/12882–1
FC21-86MC11076		Western Research Inst., Laramie, WY (USA)
	16:14168	DOE/MC/11076–2952
FC21-90MC27084		Occidental Oil Shale, Inc., Steamboat Springs, CO (USA)
	16:14195	DOE/MC/27084–2960
FC22-83FE60149		National Inst. for Petroleum and Energy Research, Bartlesville, OK (USA)
	16:14061	NIPER–466
	16:14062	NIPER–507
FC22-87PC79796		Energy and Environmental Research Corp., Irvine, CA (USA)
	16:14492	DOE/PC/79796–T10
FC22-87PC79798		Babcock and Wilcox Co., Barberton, OH (USA). Domestic Fossil Operations
	16:14493	DOE/PC/79798–T10
FC22-89PC88750		TRW, Inc., Stony Point, NY (USA). Energy Systems Group
	16:14026	DOE/PC/88750–T5
FC22-90PC89658		Bethlehem Steel Corp., PA (USA)
	16:13961	DOE/PC/89658–T2
FC22-90PC89659		Babcock and Wilcox Co., Cassville, WI (USA)
	16:13998	DOE/PC/89659–T2
FC22-90PC89663		CQ, Inc., Homer City, PA (USA)
	16:14485	DOE/PC/89663–T1
FG01-82NE34082		Belgonucleaire SA, Brussels (Belgium)
	16:14505	DOE/NE/34082–T16
	16:14506	DOE/NE/34082–T22
	16:14507	DOE/NE/34082–T23
	16:14508	DOE/NE/34082–T29
	16:14509	DOE/NE/34082–T36
	16:14510	DOE/NE/34082–T37
	16:14511	DOE/NE/34082–T38
	16:14512	DOE/NE/34082–T40
	16:14513	DOE/NE/34082–T47
	16:14514	DOE/NE/34082–T48
	16:14515	DOE/NE/34082–T49
	16:14516	DOE/NE/34082–T50
	16:14517	DOE/NE/34082–T51
FG01-88CE26579		Saint Louis Thermal Energy Corp., MO (USA)
	16:14866	DOE/CE/26579–T1
FG01-89CE15397		Lewis Engineering and Project Management, Inc., Corpus Christi, TX (USA)
	16:14087	DOE/CE/15397–T8
FG01-89IE10763		Atlantic Council of the United States, Washington, DC (USA)
	16:14686	CONF-9011186–1
FG01-90CE15466		Missouri Univ., Columbia, MO (USA). Dept. of Civil Engineering
	16:14016	DOE/CE/15466–T1
FG02-84ER13291		Wisconsin Univ., Madison, WI (USA). Dept. of Chemical Engineering
	16:15025	DOE/ER/13291–6
FG02-84ER40153		Cincinnati Univ., OH (USA)
	16:15571	DOE/ER/40153–7
FG02-85CE40740		Florida Univ., Gainesville, FL (USA). Coll. of Engineering
	16:14385	DOE/CE/40740–2
FG02-85ER13442		Michigan Univ., Ann Arbor, MI (USA)
	16:14971	DOE/ER/13442–5
FG02-85ER13451		Colorado Univ., Boulder, CO (USA). Dept. of Chemistry and Biochemistry
	16:14972	DOE/ER/13451–5
FG02-85ER53198		Wisconsin Univ., Madison, WI (USA). Dept. of Physics
	16:15877	DOE/ER/53198–169
FG02-86ER13492		Columbia Univ., New York, NY (USA). Dept. of Chemistry
	16:14990	DOE/ER/13492–T2
FG02-86ER13495		Cornell Univ., Ithaca, NY (USA). Dept. of Microbiology
	16:15337	DOE/ER/13495–T4
FG02-86ER13500		Wisconsin Univ., Madison, WI (USA)
	16:14973	DOE/ER/13500–T2
FG02-86ER13508		Cornell Univ., Ithaca, NY (USA). School of Applied and Engineering Physics
	16:14994	DOE/ER/13508–5
FG02-86ER45265		Queens Coll., Flushing, NY (USA). Dept. of Physics
	16:14899	DOE/ER/45265–4
FG02-86ER53223		New York Univ., NY (USA). Courant Inst. of Mathematical Sciences
	16:15878	DOE/ER/53223–158

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FG02-87CH10332	Fisk Univ., Nashville, TN (USA). Dept. of Physics	
	16:14244	DOE/CH/10332–1
FG02-87ER13764	Wisconsin Univ., Milwaukee, WI (USA). Dept. of Mechanical Engineering	
	16:15026	DOE/ER/13764–T2
FG02-87ER40365	Indiana Univ., Bloomington, IN (USA). Dept. of Physics	
	16:15714	DOE/ER/40365–4
FG02-87ER40371	Iowa State Univ. of Science and Technology, Ames, IA (USA)	
	16:15521	DOE/ER/40371–4
FG02-87ER45308	Colorado School of Mines, Golden, CO (USA). Center for Welding and Joining Research	
	16:14900	DOE/ER/45308–4
FG02-87ER45315	Michigan Technological Univ., Houghton, MI (USA). Dept. of Metallurgical Engineering	
	16:14891	DOE/ER/45315–15
FG02-87ER60557	Colorado Univ., Denver, CO (USA). Center for Environmental Sciences	
	16:15269	DOE/ER/60557–1
FG02-88ER13965	Rochester Univ., NY (USA)	
	16:14974	DOE/ER/13965–3
FG02-88ER13974	Cornell Univ., Ithaca, NY (USA)	
	16:14975	DOE/ER/13974–T1
FG02-88ER40479	Pennsylvania Univ., Philadelphia, PA (USA). Dept. of Physics	
	16:15535	DOE/ER/40479–3
FG02-89ER14042	Carnegie-Mellon Univ., Pittsburgh, PA (USA). Dept. of Electrical and Computer Engineering	
	16:14997	CONF-910188–1
FG02-89ER45388	Massachusetts Inst. of Tech., Cambridge, MA (USA). Dept. of Materials Science and Engineering	
	16:14901	DOE/ER/45388–1
FG02-89ER52161	Rensselaer Polytechnic Inst., Troy, NY (USA)	
	16:15926	DOE/ER/52161–T1
FG02-89ER53298	Dartmouth Coll., Hanover, NH (USA)	
	16:15883	DOE/ER/53298–2
FG02-89ER53300	Yale Univ., New Haven, CT (USA)	
	16:15884	DOE/ER/53300–1
FG02-89ER60868	Purdue Research Foundation, Lafayette, IN (USA)	
	16:14976	DOE/ER/60868–2
FG02-90ER40560	Fermi National Accelerator Lab., Batavia, IL (USA)	
	16:15540	FNAL/C–91/81-A
FG02-90ER54084	Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center	
	16:15927	DOE/ER/54084–1
FG02-91ER54109	Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center	
	16:15885	DOE/ER/54109–T1
FG02-91ER54110	Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center	
	16:15928	DOE/ET/51013–T238
FG03-86ER53220	California Univ., Berkeley, CA (USA). Electronics Research Lab.	
	16:15871	CONF-890931–12
	16:15872	CONF-890931–15
	16:15922	CONF-890931–13
	16:15869	CONF-890931–10
	16:15870	CONF-890931–11
FG03-86ER53225	Texas Univ., Austin, TX (USA). Fusion Research Center	
	16:15882	DOE/ER/53266–36
FG03-86ER60406	California Univ., Berkeley, CA (USA). Dept. of Chemistry	
	16:15340	DOE/ER/60406–T3
FG03-88ER60673	California Univ., Davis, CA (USA). Dept. of Physics	
	16:15342	DOE/ER/60673–T1
	Lawrence Livermore National Lab., CA (USA)	
	16:15344	LA-UR–91-732
	California Univ., Davis, CA (USA). Dept. of Biological Chemistry	
	16:15341	DOE/ER/60673–1
FG03-89ER40526	California Univ., Berkeley, CA (USA)	
	16:15537	DOE/ER/40526–1
FG03-90ER54079	California Univ., Berkeley, CA (USA). Electronics Research Lab.	
	16:15871	CONF-890931–12
	16:15872	CONF-890931–15
	16:15922	CONF-890931–13
	16:15869	CONF-890931–10
	16:15870	CONF-890931–11
FG03-90ER54081	General Atomics, San Diego, CA (USA)	
	16:15890	GA-C–20285
FG03-90ER60997	California Inst. of Biological Research, La Jolla, CA (USA)	
	16:15345	DOE/ER/60997–T1
FG03-90SF18437	Syracuse Univ., NY (USA). Dept. of Physics	
	16:15925	DOE/ER/18862–1
FG03-91ER18862	Syracuse Univ., NY (USA). Dept. of Physics	
	16:15925	DOE/ER/18862–1
FG04-89ER60899	RhoMed, Inc., Albuquerque, NM (USA)	
	16:15348	DOE/ER/60899–5
FG05-80ET53088	Texas Univ., Austin, TX (USA). Inst. for Fusion Studies	
	16:15887	DOE/ET/53088–481
FG05-84ER13262	Texas A and M Univ., College Station, TX (USA). Cyclotron Inst.	
	16:15485	DOE/ER/13262–7
FG05-84ER13263	North Carolina Univ., Charlotte, NC (USA). Dept. of Chemistry	
	16:14989	DOE/ER/13263–7
FG05-84ER40162	Georgia State Univ., Atlanta, GA (USA). Dept. of Physics and Astronomy	
	16:15651	DOE/ER/40162–T5
FG05-85ER40219	North Carolina Univ., Chapel Hill, NC (USA). Dept. of Physics and Astronomy	
	16:15613	CONF-9007185–1
FG05-86ER13496	Oklahoma State Univ., Stillwater, OK (USA)	
	16:15338	DOE/ER/13496–5
FG05-86ER40272	Fermi National Accelerator Lab., Batavia, IL (USA)	
	16:15540	FNAL/C–91/81-A
FG05-86ER60469	Maryland Univ., Solomons, MD (USA). Chesapeake Biological Lab.	
	16:15435	DOE/ER/60469–4
FG05-87ER13678	Oklahoma Univ., Norman, OK (USA)	
	16:14964	DOE/ER/13678–40
FG05-87ER40376	Vanderbilt Univ., Nashville, TN (USA). Dept. of Physics and Astronomy	
	16:15652	DOE/ER/40376–4
FG05-88ER40419	Texas Univ., Houston, TX (USA). Dept. of Physics	
	16:15534	DOE/ER/40419–22
FG05-88ER53266	Texas Univ., Austin, TX (USA). Fusion Research Center	
	16:15879	DOE/ER/53266–30
	16:15880	DOE/ER/53266–31

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	16:15881	DOE/ER/53266–35
	16:15882	DOE/ER/53266–36
FG05-88ER53267	Texas Univ., Austin, TX (USA). Fusion Research Center	
	16:15880	DOE/ER/53266–31
	16:15881	DOE/ER/53266–35
	16:15882	DOE/ER/53266–36
FG06-85ER40224	Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science	
	16:15572	DOE/ER/40224–158
FG06-86ER60409	Washington Univ., Seattle, WA (USA). Dept. of Biological Structure	
	16:15352	DOE/ER/60409–5
FG07-85ID12608	Purdue Univ., Lafayette, IN (USA)	
	16:15355	DOE/ID/12608–3-Vol.1
	16:15356	DOE/ID/12608–T1
	16:15357	DOE/ID/12608–T2
	16:15358	DOE/ID/12608–T3
	16:15359	DOE/ID/12608–T4
	16:15360	DOE/ID/12608–T5
	16:15361	DOE/ID/12608–T6
	16:15362	DOE/ID/12608–T10
FG07-87ID12693	Oregon Inst. of Tech., Klamath Falls, OR (USA). Geo-Heat Center	
	16:14460	DOE/ID/12693–1
FG07-88ER12824	Oak Ridge National Lab., TN (USA)	
	16:14577	CONF-910535–1
FG09-88ER13970	Georgia Univ., Athens, GA (USA). Complex Carbohydrate Research Center	
	16:15339	DOE/ER/13970–2
FG22-84PC71257	Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering	
	16:14398	CONF-900828–11
	16:14399	DOE/PC/89786–T1
FG22-86PC90504	Auburn Univ., AL (USA). Coal Conversion Lab.	
	16:13974	DOE/PC/90504–T18
FG22-87PC79915	Iowa State Univ. of Science and Technology, Ames, IA (USA)	
	16:14025	DOE/PC/79915–T12
FG22-87PC79929	Brown Univ., Providence, RI (USA). Div. of Engineering	
	16:13996	DOE/PC/79929–11
FG22-88PC88913	University of Southern California, Los Angeles, CA (USA). Dept. of Mechanical Engineering	
	16:15027	DOE/PC/88913–T8
FG22-88PC88916	Colorado Univ., Boulder, CO (USA)	
	16:13957	DOE/PC/88916–T1
FG22-88PC88924	Western Kentucky Univ., Bowling Green, KY (USA). Center for Coal Science	
	16:13987	DOE/PC/88924–9
FG22-88PC88927	Massachusetts Inst. of Tech., Cambridge, MA (USA). Dept. of Chemical Engineering	
	16:13958	DOE/PC/88927–T5
FG22-88PC88935	Pennsylvania State Univ., University Park, PA (USA). Coll. of Earth and Mineral Sciences	
	16:13959	DOE/PC/88935–T8
FG22-88PC88940	Utah Univ., Salt Lake City, UT (USA). Dept. of Fuels Engineering	
	16:13960	DOE/PC/88940–T6
FG22-89PC89755	Massachusetts Inst. of Tech., Cambridge, MA (USA)	
	16:14027	DOE/PC/89755–T2
FG22-89PC89760	Clark Atlanta Univ., GA (USA). Research Center for Science and Technology	
	16:13962	DOE/PC/89760–T2
FG22-89PC89762	North Carolina Agricultural and Technical State Univ., Greensboro, NC (USA). Dept. of Chemical Engineering	
	16:13988	DOE/PC/89762–T2
FG22-89PC89764	Alabama Univ., University, AL (USA)	
	16:13989	DOE/PC/89764–T1
	Alabama Univ., University, AL (USA). Dept. of Mineral Engineering	
	16:13990	DOE/PC/89764–T2
FG22-89PC89772	Boston Univ., MA (USA). School of Medicine	
	16:13963	DOE/PC/89772–T2
FG22-89PC89783	Oregon State Univ., Corvallis, OR (USA)	
	16:13964	DOE/PC/89783–T1
FG22-89PC89786	Pittsburgh Univ., PA (USA). Dept. of Chemical and Petroleum Engineering	
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8	16:14241	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009651	MF-721
CONF-870804–		(22. intersociety energy conversion engineering conference; Philadelphia, PA (USA); 10-14 Aug 1987)			
51	16:14882	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009646	MF-406
CONF-871008–		(Annual conference of the Water Pollution Control Federation; Philadelphia, PA (USA); 4-8 Oct 1987)			
1	16:14838	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009647	MF-721

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-871016–		(5. symposium on separation science and technology for energy applications; Knoxville, TN (USA); 25-30 Oct 1987)			
4	16:14963	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009620	MF-401
CONF-880214–		(Seminar for developing countries in Africa on food irradiation; Dakar (Senegal); 15-19 Feb 1988)			
	16:15363	*See* IAEA-TECDOC–576			
CONF-8808317–		(SHARE '71: Systems for heat and radiation energy human factors project; New York, NY (USA); 14-19 Aug 1988)			
1-Rev.	16:15995	*See* SLAC-PUB–4561-Rev.			
CONF-880943–		(Uranium and electricity: the complete nuclear fuel cycle; Saskatoon (Canada); 18-21 Sep 1988)			
	16:14196	*See* INIS-mf–12807			
CONF-8809521–		(International Congress on Optical Science and Engineering; Hambourg, DE (USA); 19-24 Sep 1988)			
	16:14962	*See* CEA-CONF–10443			
CONF-8901216–		(1. meeting of the European working group on solar thermal plant monitoring; 2. meeting of the European working group on solar thermal plant monitoring; Ispra (Italy); Ispra (Italy); 26 Jan 1989; 21-22 sep 1989)			
Summ.	16:14406	*See* EUR–12740			
CONF-890488–		(4. international symposium on ceramics in nuclear waste management; Indianapolis, IN (USA); 23-27 Apr 1989)			
	16:14942	*See* CEA-CONF–10444			
CONF-890692–		(82. Air and Waste Management Association annual meeting and exhibition; Anaheim, CA (USA); 25-30 Jun 1989)			
25	16:14812	*See* LBL–26950			
CONF-8908204–		(CERN school of computing conference; Bad Herrenalb (Germany, F.R.); 20 Aug - 2 sep 1989)			
	16:15967	*See* CERN–90-06			
CONF-8909299–		(5. French-Japanese symposium on nuclear physics: new aspects and future prospects in nuclear physics at intermediate energies; Dagashima (Japan); 26-30 Sep 1989)			
	16:15560	*See* CSNSM–8954			
CONF-890931–		(13. conference on the numerical simulation of plasmas; Santa Fe, NM (USA); 17-20 Sep 1989)			
10	16:15869	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009835	MF-421
11	16:15870	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009834	MF-421
12	16:15871	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009833	MF-421
13	16:15922	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009832	MF-421
15	16:15872	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009830	MF-421
CONF-8909406–		(1. meeting of the European working group on solar thermal plant monitoring; 2. meeting of the European working group on solar thermal plant monitoring; Ispra (Italy); Ispra (Italy); 26 Jan 1989; 21-22 sep 1989)			
	16:14406	*See* EUR–12740			
CONF-8910393–		(Workshop for asymmetric B-factory at KEK; Tsukuba (Japan); 2-4 Oct 1989)			
1	16:15556	*See* SSCL–347			
CONF-8910508–		(ASPEA information session meeting on modern nuclear power stations; Zurich (Switzerland); 19 Oct 1989)			
	16:14572	*See* Risley-Trans–5972			
CONF-8910517–		(Information day on wood chip, and coal/wood chip fired district heating plants with flue gas condensing; Frederiksberg (Denmark); 31 Oct 1989)			
	16:14387	*See* NEI-DK–498			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-891094–		(International conference on accelerator and large experimental physics control systems (ICALEPCS); Vancouver (Canada); 30 Oct - 3 nov 1989)			
	16:15076	*See* CRN-VIV–77			
CONF-8911216–		(Workshop on the contribution to the nuclear structure of light nuclei far from stability experiment and theory workshop; Overnai (France); 27-29 Nov 1989)			
	16:15713	*See* CSNSM–8959			
CONF-891129–		(Scientific basis for nuclear waste management; Boston, MA (USA); 27 Nov - 2 dec 1989)			
	16:14940	*See* CEA-CONF–10440			
	16:14941	*See* CEA-CONF–10441			
CONF-8911293–		(11. meeting of the Fachgruppe Photochemie of Gesellschaft Deutscher Chemiker (GDCh); Duisburg (Germany, F.R.); 22-24 Nov 1989)			
	16:14988	OSTI; NTIS (US Sales Only)		DE91764467	
CONF-891204–		(4. international conference on fusion reactor materials; Kyoto (Japan); 4-8 Dec 1989)			
	16:15934	*See* ECN-RX–90-041			
	16:15935	*See* ECN-RX–90-047			
	16:15939	*See* ECN-RX–90-076			
CONF-900143–		(Institute for Electronic and Electrical Engineers (IEEE) nuclear science symposium; San Francisco, CA (USA); 15-19 Jan 1990)			
38	16:15190	*See* PNL-SA–17139			
CONF-900210–		(Waste management '90: working towards a cleaner environment: waste processing, transportation, storage and disposal, technical programs and public education; Tucson, AZ (USA); 25 Feb - 1 mar 1990)			
57	16:14263	*See* EGG-M–89349			
58	16:14262	*See* EGG-M–89348			
CONF-9002109–		(Specialists' meeting on measurement, calculation and evaluation of photon production cross sections; Smolenice (Czechoslovakia); 5-7 Feb 1990)			
	16:15726	*See* INDC(NDS)–238/L			
CONF-9002178–		(OECD enlarged halden group meeting on fuel performance experiments analysis; Bolkesjoe (Norway); 11-16 Feb 1990)			
	16:14583	*See* ECN-RX–90-031			
CONF-9002180–		(Conference on decentral cogeneration plants and industrial heat and power production; Lyngby (Denmark); 28 Feb 1990)			
	16:14716	*See* NEI-DK–499			
CONF-9003100–		(International workshop on cold neutron sources; Los Alamos, NM (USA); 5-8 Mar 1990)			
5	16:14358	*See* ANL/CP–72633			
CONF-9003259–		(10. Moriond Astrophysics Meeting; Les Arcs (France); 4-10 Mar 1990)			
	16:15468	*See* LAL–9020			
CONF-900402–		(199. national meeting of the American Chemical Society (ACS); Boston, MA (USA); 22-27 Apr 1990)			
13	16:15220	*See* BNL–45879			
CONF-9004103–		(Oil shale and tar sand contractors review meeting; Morgantown, WV (USA); 18-19 Apr 1990)			
3	16:14144	OSTI; Institute of Gas Technology, 3424 South State Street, Chicago, IL 60616		TI91008394	
CONF-9004135–		(19. annual international programmable controllers conference and exposition IPC^2: expert systems '90; Detroit, MI (USA); 3-5 Apr 1990)			
2	16:14481	OSTI; Institute of Gas Technology, 3424 South State St., Chicago, IL 60616		TI91008391	
CONF-9004248–		(2. IN2-P3-RIKEN symposium on heavy-ion collisions; Obernai (France); 9-13 Apr 1990)			
	16:15688	*See* IPNO-DRE–9005			
	16:15693	*See* CRN-PN–9012			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-900505–		(9. plasma surface interactions in controlled fusion devices conference; Bournemouth (UK); 20-25 May 1990)			
15	16:15941	*See* EGG-M–89512			
CONF-9005123–		(1990 incineration conference: 9th annual international symposium on the incineration of radioactive, hazardous, mixed and medical wastes; San Diego, CA (USA); 14-18 May 1990)			
	16:14238	*See* CEA-CONF–10428			
	16:14240	*See* CEA-CONF–10431			
CONF-9005233–		(2. international conference on medium- and high-energy nuclear physics; Taipei (Taiwan); 8-18 May 1990)			
12	16:15550	*See* LA-UR–91-761			
CONF-9005297–		(Conference on experimental apparatus for high energy physics and astrophysics; San Miniato (Italy); 28 May - 1 jun 1990)			
	16:15078	*See* DESY–90-124			
CONF-9005329–		(NATO symposium; Scilly (Italy); May 1990)			
1	16:15344	*See* LA-UR–91-732			
CONF-9005332–		(2. International Seminar on Radioactive Waste Products; Juelich, DE (USA); 28 May - 1 jun 1990)			
	16:14938	*See* CEA-CONF–10427			
CONF-9005339–		(5. Workshop on carbon for fusion applications; Juelich (Germany, F.R.); 17-18 May 1990)			
	16:15936	*See* ECN-RX–90-051			
CONF-9005340–		(10. international days on Expert Systems and their Applications; Avignon (France); 28 May - 1 jun 1990)			
	16:14222	*See* CEA-CONF–10425			
	16:14223	*See* CEA-CONF–10426			
CONF-900610–		(22. national symposium on fracture mechanics; Atlanta, GA (USA); 26-28 Jun 1990)			
2	16:14893	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009936	MF-404
CONF-9006213–		(International Atomic Energy Agency (IAEA)-CRP on fast neutron cross-sections conference; Vienna (Austria); 20-22 Jun 1990)			
	16:15715	*See* ECN-RX–90-039			
CONF-9006242–		(Workshop on short pulse high current cathodes; Bendor (France); 18-22 Jun 1990)			
	16:15129	*See* LAL-RT–9011			
	16:15498	*See* LAL-RT–9004			
CONF-9006267–		(1990 DPF summer study on high energy physics; Snowmass, CO (USA); 25 Jun - 13 jul 1990)			
	16:15569	*See* DESY–90-144			
29	16:15539	*See* FNAL/C–91/66-E			
CONF-9006276–		(14. International Conference on neutrino physics and astrophysics, Neutrino 90; Cern (Switzerland); 10-15 Jun 1990)			
	16:15175	*See* LAL–9039			
CONF-9006299–		(1990 Santa Fe Institute summer school on complex systems; Santa Fe, NM (USA); 12-16 Jun 1990)			
	16:15353	*See* LA-UR–91-829			
CONF-9006328–		(Asilomar conference on circuits, systems, and computers; Pacific Grove, CA (USA); 5-8 Jun 1990)			
1	16:15998	*See* UCRL-JC–104036			
CONF-9006331–		(3. international conference on streptococcal genetics; Minneapolis, MN (USA); 6-9 Jun 1990)			
1	16:15334	*See* BNL–45931			
CONF-9006332–		(Conference on environmental planning in the Nordic countries; Stockholm (Sweden); 6-8 Jun 1990)			
1	16:14696	*See* NEI-DK–496			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-9007177–		(USNC/IIR Purdue refrigeration conference and the ASHRAE Purdue CFC conference; West Lafayette, IN (USA); 17-20 Jul 1990)			
1	16:14837	*See* BNL–45904			
CONF-9007180–		(1990 international workshop on strong coupling gauge theories and beyond; Nagoya (Japan); 28-31 Jul 1990)			
	16:15614	*See* DESY–90-118			
CONF-9007185–		(NATO advanced study institute on vacuum structure in intense fields; Cargese (France); 30 Jul - 11 aug 1990)			
1	16:15613	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010745	MF-414
CONF-900724–		(Indoor Air '90: 5th international conference on indoor air quality and climate; Toronto (Canada); 29 Jul - 3 aug 1990)			
10	16:15244	*See* LBL–27742			
CONF-900756–		(34. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; San Diego, CA (USA); 8-13 Jul 1990)			
60	16:15198	*See* EGG–10617-5039			
CONF-900799–		(18. SLAC summer institute on particle physics: heavy quarks and gauge bosons; Stanford, CA (USA); 16-27 Jul 1990)			
5	16:15538	*See* FNAL/C–90/255-E			
CONF-900801–		(25. intersociety energy conversion engineering conference; Reno, NV (USA); 12-17 Aug 1990)			
43	16:14130	OSTI; Institute of Gas Technology, 3424 S. State Street, Chicago, IL 60616		TI91008396	
CONF-900809–		(21. DOE/NRC nuclear air cleaning conference; San Diego, CA (USA); 13-16 Aug 1990)			
	16:14221	*See* CEA-CONF–10424			
	16:14237	*See* CEA-CONF–10423			
Vol.1	16:14641	*See* NUREG/CP–0116-Vol.1			
Vol.2	16:14818	*See* NUREG/CP–0116-Vol.2			
CONF-9008132–		(DOE criticality alarm workshop; Los Alamos, NM (USA); 14-16 Aug 1990)			
2	16:14347	*See* WSRC-MS–90-225			
CONF-900814–		(7. ASTM-EURATOM symposium on reactor dosimetry; Strasbourg (France); 27-31 Aug 1990)			
	16:14608	*See* ECN-RX–90-057			
	16:15162	*See* ECN-RX–90-056			
	16:15937	*See* ECN-RX–90-053			
CONF-9008198–		(Complex dynamics and biological evolution conference; Middlefart (Denmark); 6-10 Aug 1990)			
1	16:15988	*See* LA-UR–91-896			
CONF-9008199–		(22. ICHMT international symposium on manufacturing and materials processing; Dubrovnik (Yugoslavia); Aug 1990)			
1	16:15001	*See* EGG-M–90015			
CONF-900822–		(25. IUPAP international conference on high energy physics; Singapore (Singapore); 2-8 Aug 1990)			
	16:15529	*See* DESY–90-128			
	16:15602	*See* NIKHEF-H–90-20			
31	16:15153	*See* BNL–46009			
CONF-900828–		(1990 summer national meeting of the American Institute of Chemical Engineers (AIChE); San Diego, CA (USA); 19-22 Aug 1990)			
11	16:14398	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009810	MF-108
CONF-900833–		(ACEEE summer study on energy efficiency in buildings; Pacific Grove, CA (USA); 26 Aug - 1 sep 1990)			
15	16:14739	*See* LBL–30141			
CONF-900853–		(10. annual gasification and gas stream cleanup systems contractors review meeting; Morgantown, WV (USA); 28-30 Aug 1990)			
Vol.1	16:13952	*See* DOE/METC–90/6115-Vol.1			

CONF-900853–

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
Vol.2	16:13953	*See* DOE/METC–90-6115-Vol.2			
CONF-9009135–		(International conference on high spin physics and gamma-soft nuclei; Pittsburgh, PA (USA); 17-21 Sep 1990)			
	16:15698	*See* GSI–90-73(prepr.)			
CONF-9009166–		(12. international free electron laser conference (FEL-12); Paris (France); 17-21 Sep 1990)			
21	16:15103	*See* BNL–45396			
CONF-900917–		(American Nuclear Society (ANS) topical meeting on safety of commercial nuclear reactor research and irradiation facilities; Boise, ID (USA); 30 Sep - 3 oct 1990)			
37	16:14651	*See* WSRC-MS–90-20			
38	16:14628	*See* EGG-M–90056			
CONF-900918–		(16. symposium on fusion technology (SOFT); London (UK); 3-7 Sep 1990)			
	16:15938	*See* ECN-RX–90-062			
CONF-9009208–		(3. European community conference on radioactive waste management and disposal; Luxembourg (Luxembourg); 17-21 Sep 1990)			
	16:14239	*See* CEA-CONF–10430			
CONF-9009219–		(1990 joint RELAP5 and TRAC-BWR international user seminar; Chicago, IL (USA); 17-21 Sep 1990)			
8	16:14652	*See* WSRC-MS–90-205			
CONF-9009266–		(2. international colloquium on X-ray lasers; York (UK); 17-21 Sep 1990)			
12	16:15063	*See* UCRL-JC–104650			
13	16:15062	*See* UCRL-JC–104404			
CONF-9009309–		(Rheinfels workshop on hadron mass spectrum; St. Goar (Germany, F.R.); 3-6 Sep 1990)			
	16:15527	*See* DESY–90-117			
11	16:15524	*See* BNL–45844			
CONF-9009325–		(International Union of Pure and Applied Physics (IUPAP) conference on primordial nucleosynthesis and evolution of the early universe; Tokyo (Japan); 3-8 Sep 1990)			
	16:15476	*See* NORDITA–90/73-A(prepr.)			
CONF-9009353–		(Royal society conference in honor of Prof. V. Heine; London (UK); 5-6 Sep 1990)			
1	16:14897	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009120	MF-404
CONF-9009358–		(European white dwarf workshop; Toulouse (France); 7 Sep 1990)			
	16:15472	*See* NORDITA–90/65-A(prepr.)			
	16:15473	*See* NORDITA–90/66-A(prepr.)			
CONF-9009362–		(Discrete models of fluid dynamics conference; Coimbra (Portugal); Sep 1990)			
1	16:15514	*See* LA-UR–91-958			
CONF-900970–		(International conference on Monte Carlo methods in neutron and photon transport; Budapest (Hungary); 25-28 Sep 1990)			
6	16:15760	*See* ANL/CP–71146			
CONF-900980–		(ENS/ANS/FORATOM joint European Nuclear Congress and technology/industry exposition: looking into nuclear's future in the 21st century; Lyon (France); 23-28 Sep 1990)			
	16:14996	*See* CEA-CONF–10438			
CONF-901007–		(9. topical meeting on technology of fusion energy; Oak Brook, IL (USA); 7-11 Oct 1990)			
63	16:15921	*See* ANL/CP–70627			
CONF-9010105–		(4. biennial IEEE conference on electromagnetic field computation; Toronto (Canada); 22-24 Oct 1990)			
2	16:15144	*See* ANL/CP–72656			
CONF-9010183–		(European workshop on hadronic physics with electrons beyond 10 GeV; Dourdan (France); 8-12 Oct 1990)			
3	16:15551	*See* LA-UR–91-987			
CONF-9010185–		(18. water reactor safety information meeting; Gaithersburg, MD (USA); 22-24 Oct 1990)			
25	16:14615	*See* BNL-NUREG–45799			

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26	16:14655	*See* BNL-NUREG–44787			
CONF-9010243–		(International collaboration on advanced neutron sources; Tsukuba (Japan); 21-26 Oct 1990)			
16	16:15151	*See* ANL/CP–72394			
CONF-9010267–		(1990 workshop on accelerator instrumentation; Batavia, IL (USA); 1-4 Oct 1990)			
4	16:15143	*See* ANL/CP–72575			
CONF-9010283–		(International conference on calorimetry in high energy physics; Batavia, IL (USA); 29 Oct 1990)			
5	16:15176	*See* LBL–30207			
6	16:15152	*See* ANL-HEP-CP–90-123			
CONF-9010287–		(22. Boulder damage symposium; Boulder, CO (USA); 25-26 Oct 1990)			
7	16:14957	*See* UCRL-JC–105106			
CONF-9010291–		(Large Hadron Collider (LHC) workshop: physics and instrumentation; Aachen (Germany, F.R.); 4-9 Oct 1990)			
	16:15145	*See* CERN–90-10(v.3)			
	16:15526	*See* CERN–90-10(v.1)			
CONF-9010296–		(International workshop on radiative properties of hot dense matter; Sarasota, FL (USA); 22-26 Oct 1990)			
7	16:15823	*See* UCRL-JC–105920			
CONF-9010327–		(1. annual Automated Resource for Chemical Hazard Incident Evaluations (ARCHIE) conference; Houston, TX (USA); 22-25 Oct 1990)			
1	16:14056	*See* SAND–90-1074C			
CONF-9010330–		(18. water reactor safety information meeting; Washington, DC (USA); 22-24 Oct 1990)			
1	16:14613	*See* BNL-NUREG–44785			
CONF-9010339–		(10. National Scientific Technical Conference with International Participation: Glass and Fine Ceramics; Varna (Bulgaria); 18-20 Oct 1990)			
	16:14939	*See* CEA-CONF–10439			
CONF-901047–		(SPIE international conference on physical concepts of materials for novel optoelectronic devices applications; Aachen (Germany, F.R.); 27 Oct - 2 nov 1990)			
2	16:14956	*See* SAND–91-0586C			
CONF-901072–		(LATTICE '90: 7th international lattice gauge theory conference; Tallahassee, FL (USA); 8-12 Oct 1990)			
	16:15617	*See* DESY–90-159			
	16:15861	*See* NBI-HE–90-76			
13	16:15559	*See* BNL–45575			
14	16:15558	*See* BNL–45455			
CONF-901105–		(Fall meeting of the Materials Research Society; Boston, MA (USA); 24 Nov - 1 dec 1990)			
109	16:14314	*See* UCRL-JC–104531			
CONF-9011136–		(10. international workshop on electron cyclotron resonance ion sources (ECRIS); Knoxville, TN (USA); 1-2 Nov 1990)			
	16:15107	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010494	MF-420
CONF-9011164–		(1990 scientific conference on chemical defense research; Aberdeen Proving Ground, MD (USA); 14-18 Nov 1990)			
2	16:15437	*See* LA-UR–91-782			
CONF-9011167–		(International colloquium on neutron radiation biology; Rockville, MD (USA); 5-7 Nov 1990)			
3	16:15383	*See* ANL/CP–71416			
CONF-9011174–		(32. meeting of the Weapons Agencies Nondestructive Testing Organization (WANTO); Aiken, SC (USA); 27-29 Nov 1990)			
	16:14582	*See* WSRC-MS–91-026			
CONF-9011177–		(Polarized collider workshop; University Park, PA (USA); 15-17 Nov 1990)			
7	16:15523	*See* ANL-HEP-CP–91-03			

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CONF-9011183–		(Potential applications of concentrated solar photons workshop; Golden, CO (USA); 7-8 Nov 1990)			
1	16:14892	*See* ANL/CP–72530			
CONF-9011186–		(US/Japan energy policy dialogue; Washington, DC (USA); 8 Nov 1990)			
1	16:14686	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009538	MF-900
CONF-9011188–		(Institute for Cosmic Ray Research (ICRR) international symposium on astrophysical aspects of the most energetic cosmic rays; Kofu (Japan); 26-29 Nov 1990)			
1	16:15461	*See* FNAL/C–91/56-A			
CONF-9011192–		(14. Italian National Institute of Nuclear Physics (INFN) workshop: data structures for particle physics experiments; Erice (Italy); 11-18 Nov 1990)			
1	16:16025	*See* SLAC-PUB–5450			
CONF-901125–		(2. international ceramic science and technology congress; Orlando, FL (USA); 12-15 Nov 1990)			
11	16:14930	*See* LA-UR–91-887			
CONF-901141–		(International conference on trends in astroparticle physics; Santa Monica, CA (USA); 26 Nov - 1 dec 1990)			
4	16:15540	*See* FNAL/C–91/81-A			
CONF-901144–		(Vacuum design of advanced synchrotron light sources; Argonne, IL (USA); 13-15 Nov 1990)			
4	16:15141	*See* ANL/CP–72471			
5	16:15142	*See* ANL/CP–72484			
CONF-901194–		(American Society of Mechanical Engineers (ASME) winter annual meeting; Dallas, TX (USA); 25-30 Nov 1990)			
16	16:15101	*See* BNL–44530			
CONF-901219–		(International symposium on heavy ion inertial fusion; Monterey, CA (USA); 3-6 Dec 1990)			
6-Rev.	16:15954	*See* UCRL-JC–104981-Rev.1			
CONF-901226–		(4. international symposium on neutron capture therapy; Sydney (Australia); 3-7 Dec 1990)			
1	16:15347	*See* BNL–45809			
CONF-901273–		(Materials Research Society meeting; Boston, MA (USA); Dec 1990)			
3	16:14934	*See* PNL-SA–18573			
CONF-901277–		(Yoshio Nishina centennial symposium on evolutional trends of physical sciences; Tokyo (Japan); 5-7 Dec 1990)			
	16:15654	*See* GSI–91-03(prepr.)			
CONF-901280–		(The American Society of Agricultural Engineers (ASAE) conference; Chicago, IL (USA); 18-21 Dec 1990)			
1	16:15325	*See* SAND–91-0476C			
2	16:15229	*See* EGG-M–90553			
CONF-901285–		(USAF/DOE workshop on solvent substitution; Phoenix, AZ (USA); Dec 1990)			
1	16:14699	*See* SAND–90-2838C			
CONF-910111–		(14. international winter meeting on nuclear physics; Bormio (Italy); 21-25 Jan 1991)			
	16:15699	*See* CEA-LNS-PH–91-02			
CONF-910123–		(OE/LASE '91: 4th Society of Photo-Optical Instrumentation Engineers (SPIE) international symposium; Los Angeles, CA (USA); 20-25 Jan 1991)			
18	16:15055	*See* SAND–90-1745C			
19	16:15441	*See* LA-UR–91-905			
20	16:15947	*See* LA-UR–91-985			
21	16:15050	*See* EGG-M–91041			
22	16:15083	*See* BNL–45802			
CONF-910145–		(Electronic structure and mechanisms for high temperature superconductivity; Coral Gables, FL (USA); 3-9 Jan 1991)			
2	16:15827	*See* LA-UR–91-893			
3	16:14931	*See* LA-UR–91-892			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-910169–		(International panel on 14 MeV intense neutron source based on accelerators for fusion material studies; Tokyo (Japan); 14-16 Jan 1991)			
Summ.	16:15949	*See* NIFS-WS–2			
CONF-910186–		(Engineering Foundation conference; Santa Barbara, CA (USA); 1-11 Jan 1991)			
1	16:14935	*See* UCRL-JC–105376			
CONF-910188–		(International symposium on intelligent robotics; Bangalore (India); Jan 1991)			
1	16:14997	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009414	MF-406
CONF-910190–		(Workshop on electronic structures and mechanisms for high temperature superconductivity; Miami, FL (USA); 3-9 Jan 1991)			
1	16:15830	*See* ORNL/CCIP–91/03			
2	16:14932	*See* LA-UR–91-964			
CONF-910194–		(Buildings sector field program planning workshop; Oak Ridge, TN (USA); 29-31 Jan 1991)			
Summ.	16:14819	*See* ORNL/M–1410			
CONF-910195–		(School on electromagnetic interactions with intermediate energy hadrons; Folgaria (Italy); 27 Jan - 3 feb 1991)			
1-Exc.	16:15071	*See* BNL–45935			
CONF-910202–		(Annual meeting and exhibition of the Minerals, Metals and Materials Society (TMS); New Orleans, LA (USA); 17-21 Feb 1991)			
8	16:14921	*See* UCRL-JC–106552			
CONF-9102102–		(Symposium on surface science; Obertraun (Austria); 10-16 Feb 1991)			
1	16:15824	*See* UCRL-JC–106476			
CONF-9102103–		(3. seminar on computational electromagnetics; Tokyo (Japan); 4-5 Feb 1991)			
1	16:15100	*See* ANL/CP–72647			
CONF-910212–		(High-temperature superconductors: processing and microstructure property relationships; New Orleans, LA (USA); 17-21 Feb 1991)			
3	16:14937	*See* ANL/CP–70841			
4	16:14923	*See* ANL/CP–71063			
CONF-910228–		(Meeting on rare and exclusive b and k decays; Santa Monica, CA (USA); 12-13 Feb 1991)			
1	16:15140	*See* UCRL-JC–106803			
CONF-910265–		(Texas Center for Superconductivity workshop on the physics and mathematics of anyons; Houston, TX (USA); 1-2 Feb 1991)			
2	16:15828	*See* LA-UR–91-939			
CONF-910270–		(Waste management '91; Tucson, AZ (USA); 24-28 Feb 1991)			
30	16:14319	*See* WSRC-MS–90-266			
31	16:14318	*See* WHC-SA–1119			
33	16:14317	*See* WHC-SA–1118			
35	16:15330	*See* WHC-SA–0989			
39	16:14264	*See* EGG-M–91103			
CONF-910278–		(2. international symposium on field screening methods for hazardous wastes and toxic chemicals; Las Vegas, NV (USA); 12-14 Feb 1991)			
5	16:15287	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009563	MF-403
CONF-910279–		(Environmentally conscious manufacturing/technology applications workshop; Albuquerque, NM (USA); 20-21 Feb 1991)			
8	16:15256	*See* SAND–91-0454C			
13	16:15255	*See* SAND–91-0444C			
CONF-910292–		(National electronics products conference (NEPCON); Anaheim, CA (USA); Feb 1991)			
1	16:15064	*See* UCRL-JC–105120			
CONF-910298–		(4. annual workshop on the recent development of computer simulation studies in condensed matter physics; Athens, GA (USA); 18-22 Feb 1991)			
1	16:14924	*See* BNL–45806			

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CONF-910299–		(Safeguards workshop on measurement control; Albuquerque, NM (USA); 20-22 Feb 1991)			
1	16:14349	*See* MLM–3684			
CONF-9103109–		(SOLTECH '91 conference; Burlingame, CA (USA); 25-28 Mar 1991)			
1-Vugraphs	16:14434	*See* SAND–91-0570C			
CONF-9103110–		(Advanced solid-state lasers topical meeting; Hilton Head, SC (USA); 18-20 Mar 1991)			
1	16:15051	*See* LA-UR–91-902			
CONF-9103112–		(Conference on fermiology of high T_c superconductors; Argonne, IL (USA); 25-27 Mar 1991)			
1	16:15829	*See* LA-UR–91-1013			
CONF-9103114–		(In situ and on-site bioreclamation: an international symposium; San Diego, CA (USA); 19-21 Mar 1991)			
1	16:15438	*See* PNL-SA–18965			
2	16:15324	*See* PNL-SA–19276			
CONF-9103133–		(7. international conference on advanced science and technology; Argonne, IL (USA); 30 Mar 1991)			
2	16:15965	*See* ANL/CP–72651			
CONF-9103134–		(Lunar and planetary science conference; Houston, TX (USA); 18-22 Mar 1991)			
2	16:15458	*See* ANL/CP–72318			
CONF-9103136–		(5. national conference on undergraduate research; Pasadena, CA (USA); 21-23 Mar 1991)			
2	16:15817	*See* LA-UR–91-854			
3	16:15989	*See* LA-UR–91-903			
CONF-9103139–		(DOE/LLNL information management systems for nuclear test treaty verification symposium; Lake Tahoe, CA (USA); 5-7 Mar 1991)			
1	16:15993	*See* PNL-SA–19189			
CONF-9103140–		(Workshop on the future of human radiation research; Schloss-Elmau (Germany, F.R.); 4-8 Mar 1991)			
1	16:15430	*See* PNL-SA–18927			
2	16:15429	*See* PNL-SA–18907			
CONF-9103141–		(Keystone symposium on monoclonal antibodies; Denver, CO (USA); 10-16 Mar 1991)			
1	16:15348	*See* DOE/ER/60899–5			
CONF-9103142–		(1991 Nuclear Plant Aging Research (NPAR) review group meeting; Rockville, MD (USA); 26-28 Mar 1991)			
1-Vugraphs	16:14578	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009629	
2-Summ.	16:14621	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009557	
CONF-9103145–		(Spring meeting of the western states section of the combustion institute; Boulder, CO (USA); 17-19 Mar 1991)			
1	16:14044	*See* UCRL-JC–106115			
CONF-9103146–		(3. US/Mexico atomic and molecular physics workshop; Mexico City (Mexico); 13-16 Mar 1991)			
1	16:15483	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009917	MF-411
2	16:15484	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010779	MF-411
CONF-9103153–		(5. affordable comfort conference; Philadelphia, PA (USA); 12 Mar 1991)			
1	16:14783	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010142	MF-350
CONF-910322–		(7. Oxford conference on microscopy of semiconducting materials; London (UK); 25-28 Mar 1991)			
1	16:14952	*See* LA-UR–91-1043			
CONF-910331–		(5. symposium on integrated environmental control for energy systems; New Orleans, LA (USA); 4-5 Mar 1991)			
1	16:14489	*See* ANL/CP–72548			
CONF-910340–		(International industrial symposium on the super collider; Atlanta, GA (USA); 13-15 Mar 1991)			
1	16:15139	*See* SSCL–374			
2	16:15138	*See* SSCL–372			
3	16:15111	*See* FNAL/C–91/69			

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4	16:15956	*See* FNAL-TM–1722			
6	16:15082	*See* SSCL–371			
7	16:15113	*See* FNAL-TM–1731			
CONF-910378–		(4. annual electric utility business environment conference and exhibition; Denver, CO (USA); 20-22 Mar 1991)			
1	16:14733	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009523	MF-220
CONF-9104109–		(4. international school for space simulation; Nara (Japan); 1-5 Apr 1991)			
3	16:15513	*See* LA-UR–91-0911			
CONF-9104123–		(1991 solar power systems conference; Yalta (USSR); 22-26 Apr 1991)			
2	16:14427	*See* SAND–91-0582C			
CONF-9104135–		(9. symposium on the training of nuclear facility personnel; Denver, CO (USA); 14-18 Apr 1991)			
	16:14622	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010496	MF-500
2	16:14346	*See* WHC-SA–1106			
3	16:14610	*See* WHC-SA–1107			
CONF-910414–		(International topical meeting on advances in mathematics, computation and reactor physics; Pittsburgh, PA (USA); 28 Apr - 2 may 1991)			
26	16:15781	*See* LA-UR–91-863			
27	16:14629	*See* EGG-M–90354			
28	16:15028	*See* EGG-M–90365			
29	16:15511	*See* EGG-M–90413			
31	16:14576	*See* KAPL–4723			
32	16:15779	*See* KAPL–4724			
33	16:15778	*See* KAPL–4721			
34	16:14574	*See* ANL/CP–71385			
CONF-9104163–		(1991 international conference on lightning and static electricity; Cocoa Beach, FL (USA); 16-19 Apr 1991)			
3	16:15228	*See* EGG-M–90364			
4	16:14656	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010786	MF-221
CONF-9104165–		(National American Institute of Chemical Engineers (AIChE) meeting; Houston, TX (USA); 7-11 Apr 1991)			
1	16:15969	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009558	MF-405
CONF-9104171–		(11. AIAA aerodynamic decelerator systems technology conference; San Diego, CA (USA); 9-11 Apr 1991)			
6	16:15210	*See* SAND–91-0531C			
7	16:15208	*See* SAND–90-2178C			
CONF-9104173–		(NCGA '91 conference and exposition; Chicago, IL (USA); 22-25 Apr 1991)			
2	16:16000	*See* UCRL-JC–105515			
CONF-9104174–		(3. international conference on improved coal-fired power plants; San Francisco, CA (USA); 2-5 Apr 1991)			
1	16:14898	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009931	MF-114
CONF-9104179–		(Petrochemical exposition; Houston, TX (USA); 9-11 Apr 1991)			
1	16:15970	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009630	MF-406
CONF-9104187–		(International conference on metallurgical coatings and thin films; San Diego, CA (USA); 22-26 Apr 1991)			
1	16:14925	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010131	MF-404
CONF-9104191–		(International symposium on fluids for district heating; Copenhagen (Denmark); 10-11 Apr 1991)			
1	16:15023	*See* ANL/CP–72534			
CONF-9104193–		(3. tornado symposium; Norman, OK (USA); 2-5 Apr 1991)			
1	16:15443	*See* LA-UR–91-556			
CONF-9104198–		(1991 international HP 82000 user group meeting; Tampa, FL (USA); 4 Apr 1991)			
1	16:15061	*See* SAND–91-0560C			

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CONF-9104203–		(Soft-x-ray projection lithography topical meeting; Monterey, CA (USA); 10-12 Apr 1991)			
1	16:15819	*See* LBL–30057			
CONF-9104205–		(Synergic resources conference; Arlington, VA (USA); 22-24 Apr 1991)			
1	16:14498	*See* ANL/CP–72714			
CONF-9104206–		(American Society for Precision Engineering conference; Tucson, AZ (USA); 15-18 Apr 1991)			
1	16:14911	*See* LA-UR–91-884			
CONF-9104210–		(International Atomic Energy Agency (IAEA) technical committee meeting on drivers for inertial confinement fusion (ICF); Osaka (Japan); 15-19 Apr 1991)			
1	16:15953	*See* SAND–91-0043C			
CONF-910425–		(10. European photovoltaic solar energy conference and exhibition; Lisbon (Portugal); 8-12 Apr 1991)			
1	16:14412	*See* SAND–90-2164C			
CONF-910435–		(American Nuclear Society (ANS) international high level radioactive waste management conference; Las Vegas, NV (USA); 28 Apr - 3 may 1991)			
57	16:15003	*See* EGG-M–90398			
58	16:15004	*See* EGG-M–90541			
59	16:15002	*See* EGG-M–90397			
61	16:15279	*See* ANL/CP–71530			
CONF-910450–		(SPIE international symposium on optical engineering and photonics in aerospace sensing; Orlando, FL (USA); 1-5 Apr 1991)			
3	16:15014	*See* SAND–91-0649C			
4	16:15015	*See* SAND–91-0650C			
CONF-910504–		(Custom integrated circuits conference; San Diego, CA (USA); 12-15 May 1991)			
1	16:15057	*See* SAND–90-2900C			
CONF-910505–		(Particle accelerator conference; San Francisco, CA (USA); 6-9 May 1991)			
2	16:15102	*See* BNL–45389			
3	16:15130	*See* LA-UR–91-1110			
CONF-9105126–		(14. DOE computer security group conference; Concord, CA (USA); 7-9 May 1991)			
2	16:15987	*See* LA-UR–91-820			
CONF-9105135–		(IEEE instrumentation/measurement technology conference; Atlanta, GA (USA); 14-16 May 1991)			
2	16:15049	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009121	
CONF-9105137–		(2. international conference on supercritical fluids; Boston, MA (USA); 20-22 May 1991)			
2	16:15509	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009152	MF-406
CONF-9105138–		(Chevron-Notch fracture test experience metals and non-metals conference; Indianapolis, IN (USA); 6 May 1991)			
1	16:14926	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009117	MF-332
CONF-9105148–		(1. international conference on web handling; Stillwater, OK (USA); 19-21 May 1991)			
1	16:14954	*See* SAND–90-3049C			
2	16:14955	*See* SAND–90-3129C			
3	16:15013	*See* SAND–90-3182			
CONF-9105155–		(42. international appliance technology conference; Madison, WI (USA); May 1991)			
1	16:14827	*See* SERI/TP–253-4124			
CONF-9105157–		(6. annual Goddard conference on space applications of artificial intelligence; Greenbelt, MD (USA); 13-15 May 1991)			
1	16:14586	*See* EGG-M–91009			
2	16:15974	*See* EGG-M–90462			
CONF-9105160–		(North America INGRES Users Association annual (NAIUA) meeting; San Jose, CA (USA); 19-23 May 1991)			
1	16:16026	*See* UCRL-JC–105865			
2	16:16027	*See* UCRL-JC–106617			

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CONF-910530–		(International conference and workshop on modeling and mitigating the consequences of accidental releases of hazardous materials; New Orleans, LA (USA); 6-10 May 1991)			
1	16:15263	*See* UCRL-JC–105011			
CONF-910535–		(6. specialists meeting on reactor noise (SMORN); Gatlinburg, TN (USA); 19-24 May 1991)			
1	16:14577	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009560	MF-520
2	16:14606	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009637	MF-523
CONF-910552–		(179. meeting of the Electrochemical Society; Washington, DC (USA); 5-10 May 1991)			
9	16:14668	*See* ANL/CP–72112			
CONF-910559–		(10. annual international incineration conference: environmental concerns and controls; Knoxville, TN (USA); 13-17 May 1991)			
1	16:14293	*See* LA-UR–91-907			
CONF-910595–		(CLEO '91: conference on lasers and electro-optics; Baltimore, MD (USA); 12-17 May 1991)			
7	16:15066	*See* UCRL-JC–105286			
8	16:15065	*See* UCRL-JC–105285			
CONF-910598–		(37. Instrument Society of America international instrumentation symposium; San Diego, CA (USA); 5-9 May 1991)			
3	16:14630	*See* EGG-M–91043			
4	16:15199	*See* EGG–10617-1109			
CONF-910601–		(36. international gas turbine and aeroengine congress and exposition: ASME turbo expo; Orlando, FL (USA); 3-6 Jun 1991)			
1	16:13947	OSTI; NTIS; GPO Dep.	E 1.99:	DE91004540	MF-109
2	16:14873	OSTI; NTIS; GPO Dep.	E 1.99:	DE91005516	MF-336
CONF-910602–		(American Society of Mechanical Engineers (ASME) pressure vessels and piping conference; San Diego, CA (USA); 23-27 Jun 1991)			
1	16:14617	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91001635	
2	16:15024	OSTI; NTIS; GPO Dep.	E 1.99:	DE91006001	MF-406
3	16:14330	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91006039	MF-506
4	16:14998	OSTI; NTIS; GPO Dep.	E 1.99:	DE91006392	MF-406
5	16:15035	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91006472	
6	16:14650	*See* WHC-SA–0988			
7	16:14590	*See* WSRC-MS–90-192			
8	16:14537	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007326	MF-530
9	16:14614	*See* BNL-NUREG–45736			
10	16:14585	*See* BNL-NUREG–45748			
11	16:15012	*See* SAND–90-3064C			
12	16:14311	*See* SAND–90-3065C			
13	16:14618	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009125	
14	16:14619	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009554	
15	16:14894	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009937	MF-105
16	16:14895	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009919	MF-506
18	16:14542	*See* WHC-SA–1007			
20	16:15017	*See* WHC-SA–1009			
23	16:16002	*See* WHC-SA–1006			
CONF-910603–		(Annual meeting of the American Nuclear Society (ANS); Orlando, FL (USA); 2-6 Jun 1991)			
1	16:14226	OSTI; NTIS; GPO Dep.	E 1.99:	DE91006335	MF-406
2	16:14620	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007275	
3	16:15672	*See* LA-UR–91-3			
4	16:14290	*See* LA-UR–91-100			
5	16:14292	*See* LA-UR–91-155			
6	16:14291	*See* LA-UR–91-148			
7	16:14575	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007676	MF-406
8	16:14359	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007860	MF-413
9	16:14337	*See* FMPC–2220			
CONF-910609–		(18. European conference on controlled fusion and plasma physics; Berlin (Germany, F.R.); 3-7 Jun 1991)			
1	16:15873	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010145	MF-426
2	16:15874	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010382	MF-420
3	16:15875	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010391	MF-421

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4	16:15876	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010390	MF-426
5	16:15923	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010782	MF-420
CONF-9106103–		(10. Institute of Electrical and Electronics Engineers (IEEE) symposium on computer arithmetic; Grenoble (France); 26-28 Jun 1991)			
1	16:15971	OSTI; NTIS; GPO Dep.	E 1.99:	DE91006047	MF-405
CONF-9106112–		(International conference on game theory; Florence (Italy); 25-27 Jun 1991)			
1	16:14890	*See* UCRL-JC–105885			
CONF-9106114–		(1991 cavitation and multiphase flow conference; Portland, OR (USA); 23-26 Jun 1991)			
1	16:15517	*See* SAND–90-3227C			
CONF-9106115–		(CG international conference; Cambridge, MA (USA); 27-29 Jun 1991)			
1	16:15999	*See* UCRL-JC–105185			
CONF-9106117–		(International conference on artificial neural networks; Helsinki (Finland); 24-28 Jun 1991)			
1	16:15986	*See* LA-UR–91-126			
CONF-9106118–		(1991 Institute of Electrical and Electronics Engineers (IEEE) AP-S symposium; Ontario (Canada); 24-28 Jun 1991)			
1	16:15858	*See* LA-UR–91-226			
2	16:15060	*See* SAND–91-0445C			
CONF-9106119–		(IAU colloquium 128: the magnetospheric structure and emission mechanisms of radio pulsars'; Logow (Poland); 18 Jun 1991)			
1	16:15477	*See* UCRL-JC–105642			
2	16:15478	*See* UCRL-JC–105643			
CONF-9106120–		(Recent advances on mechanics of structure continua ASME applied mechanics conference; Columbus, OH (USA); 16-19 Jun 1991)			
1	16:15288	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007677	MF-403
CONF-9106130–		(Stainless steels '91; Chiba (Japan); 10-13 Jun 1991)			
1	16:14920	*See* UCRL-CR–106146			
2	16:14914	*See* LBL–30254			
CONF-9106131–		(1991 Society for Experimental Mechanics spring conference; Milwaukee, WI (USA); 9-13 Jun 1991)			
1	16:14943	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008883	
CONF-9106132–		(2. international workshop on long-term thermal performance of cellular plastics; Ontario (Canada); 5-7 Jun 1991)			
1	16:14787	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009144	MF-350
CONF-910614–		(Special emphasis symposium on superalloys 718, 625, and various derivatives; Pittsburgh, PA (USA); 23-26 Jun 1991)			
1	16:14896	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007706	MF-504
2	16:14918	*See* SAND–91-0499C			
CONF-9106148–		(2. plasma-technik symposium; Lucerne (Switzerland); 5-7 Jun 1991)			
1	16:15952	*See* SAND–90-2357C			
CONF-910617–		(4. international symposium on ceramic materials and components for engines; Goeteborg (Sweden); 10-12 Jun 1991)			
1	16:14874	OSTI; NTIS; GPO Dep.	E 1.99:	DE91006274	MF-336
CONF-910627–		(8. symposium on space nuclear power system; Albuquerque, NM (USA); 6-9 Jun 1991)			
1	16:15054	*See* SAND–90-1712C			
CONF-910636–		(ASHRAE summer meeting; Indianapolis, IN (USA); 22-26 Jun 1991)			
1	16:14839	OSTI; NTIS; GPO Dep.	E 1.99:	DE90016034	MF-406
2	16:14999	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007282	
CONF-910637–		(5. international conference on advanced robotics; Pisa (Italy); 20-22 Jun 1991)			
1	16:15346	*See* LA-UR–90-2884			
CONF-910638–		(1991 American control conference; Boston, MA (USA); 26 Jun 1991)			
1	16:15994	*See* SAND–90-2231C			
2	16:15000	OSTI; NTIS; GPO Dep.	E 1.99:	DE90017742	MF-406

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3	16:15985	*See* LA-UR–90-4168			
4	16:15990	*See* LA-UR–91-992			
CONF-910640–		(8. IEEE pulsed power conference; San Diego, CA (USA); 17-19 Jun 1991)			
1	16:15081	*See* SAND–90-2883C			
2	16:15056	*See* SAND–90-2780C			
CONF-910648–		(4. international conference on industrial and engineering applications of artificial intelligence and expert systems; Kauai, HI (USA); 2-5 Jun 1991)			
1	16:15968	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE90017693	MF-506
CONF-910651–		(10. AIAA computational fluid dynamics conference in conjunction with the 22nd AIAA fluid dynamics, plasma dynamics and lasers conference and the 26th AIAA thermophysics conference; Honolulu, HI (USA); 24-26 Jun 1991)			
1	16:15519	*See* UCRL-JC–105182			
2	16:15520	*See* UCRL-JC–105183			
CONF-910659–		(84. annual meeting and exhibition of the Air and Waste Management Association (AWMA); Vancouver (Canada); 16-21 Jun 1991)			
1	16:14217	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008807	MF-901
2	16:14242	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009143	MF-721
3	16:15265	*See* UCRL-JC–105277			
4	16:15433	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009556	MF-402
5	16:15264	*See* UCRL-JC–105271			
8	16:15434	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009934	MF-407
9	16:15241	*See* LA-UR–91-825			
10	16:15242	*See* LA-UR–91-847			
11	16:16001	*See* UCRL-JC–106647			
12	16:15266	*See* UCRL-JC–106798			
CONF-910664–		(4. ASME-JSME international symposium on liquid-solid flow; Portland, OR (USA); 23-26 Jun 1991)			
1	16:15512	*See* LA-UR–90-3383			
CONF-910684–		(1. ASME/JSME fluids engineering conference; Portland, OR (USA); 23-26 Jun 1991)			
1	16:15516	*See* SAND–90-2541C			
2	16:15515	*See* SAND–90-1850C			
3	16:14902	*See* EGG-M–90469			
CONF-910689–		(ACM symposium on solid modeling foundations and CAD/CAM applications; Austin, TX (USA); 5-7 Jun 1991)			
1	16:15011	*See* SAND–90-2641C			
CONF-910690–		(International microwave symposium; Boston, MA (USA); 11-14 Jun 1991)			
1	16:15058	*See* SAND–90-3189C			
2	16:15059	*See* SAND–91-0381C			
CRIE-T–					
89059	16:14875	OSTI; NTIS (US Sales Only)		DE91764238	
89067	16:14665	OSTI; NTIS (US Sales Only)		DE91764239	
89074	16:14669	OSTI; NTIS (US Sales Only)		DE91764240	
CRN-PN–					
9012	16:15693	OSTI; NTIS (US Sales Only)		DE91767814	
CRN-VIV–					
74	16:15075	OSTI; NTIS (US Sales Only)		DE91767822	
75	16:15088	OSTI; NTIS (US Sales Only)		DE91767793	
77	16:15076	OSTI; NTIS (US Sales Only)		DE91767816	
79	16:15077	OSTI; NTIS (US Sales Only)		DE91767797	
81	16:15108	OSTI; NTIS (US Sales Only)		DE91767795	
CSNSM–					
8954	16:15560	OSTI; NTIS (US Sales Only)		DE91767818	
8959	16:15713	OSTI; NTIS (US Sales Only)		DE91767819	
CTH-IE-A–					
90-186	16:15261	*See* STEV-FBT–91-2			
DEFU-KR–					
85(pt.1)	16:14657	OSTI; NTIS (US Sales Only)		DE91763408	
85(pt.2)	16:14658	OSTI; NTIS (US Sales Only)		DE91763409	
85(pt.3)	16:14659	OSTI; NTIS (US Sales Only)		DE91763410	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DESY–					
90-113	16:15089	OSTI; NTIS (US Sales Only); INIS		DE91764669	
90-114	16:15561	OSTI; NTIS (US Sales Only); INIS		DE91764664	
90-116	16:15562	OSTI; NTIS (US Sales Only); INIS		DE91764665	
90-117	16:15527	OSTI; NTIS (US Sales Only); INIS		DE91764663	
90-118	16:15614	OSTI; NTIS (US Sales Only); INIS		DE91764666	
90-121	16:15528	OSTI; NTIS (US Sales Only); INIS		DE91764662	
90-122	16:15563	OSTI; NTIS (US Sales Only); INIS		DE91764667	
90-124	16:15078	OSTI; NTIS (US Sales Only); INIS		DE91764661	
90-125	16:15564	OSTI; NTIS (US Sales Only); INIS		DE91764660	
90-126	16:15615	OSTI; NTIS (US Sales Only); INIS		DE91764659	
90-127	16:15565	OSTI; NTIS (US Sales Only); INIS		DE91764658	
90-128	16:15529	OSTI; NTIS (US Sales Only); INIS		DE91764657	
90-130	16:15566	OSTI; NTIS (US Sales Only); INIS		DE91764656	
90-138	16:15530	OSTI; NTIS (US Sales Only); INIS		DE91764654	
90-139	16:15567	OSTI; NTIS (US Sales Only); INIS		DE91764655	
90-140	16:15568	OSTI; NTIS (US Sales Only); INIS		DE91764668	
90-144	16:15569	OSTI; NTIS (US Sales Only); INIS		DE91764715	
90-147	16:15159	OSTI; NTIS (US Sales Only); INIS		DE91768986	
90-149	16:15531	OSTI; NTIS (US Sales Only); INIS		DE91768989	
90-154	16:15570	OSTI; NTIS (US Sales Only); INIS		DE91768988	
90-158	16:15616	OSTI; NTIS (US Sales Only); INIS		DE91768987	
90-159	16:15617	OSTI; NTIS (US Sales Only); INIS		DE91768983	
90-161	16:15611	OSTI; NTIS (US Sales Only); INIS		DE91768984	
DESY-FH1T–					
90-02	16:15160	OSTI; NTIS (US Sales Only); INIS		DE91768978	
90-04	16:15161	OSTI; NTIS (US Sales Only); INIS		DE91764622	
DOE/AD–					
0005	16:15958	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009745	MF-900
DOE/BP–					
1427	16:14788	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009692	MF-350
1436	16:14734	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009710	MF-900
1479	16:14482	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009685	MF-900
1487	16:14747	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009700	MF-241
1512	16:14735	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009686	MF-920
1516	16:14789	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009689	MF-350
DOE/BP/07096–					
1	16:15332	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009784	MF-902
DOE/BP/14383–					
4	16:15289	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009704	MF-908
DOE/BP/16475–					
1	16:14403	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009785	MF-902
DOE/BP/17579–					
2	16:15290	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009706	MF-600
DOE/BP/23821–					
5	16:14790	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009699	MF-350
6	16:14791	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009697	MF-920
DOE/BP/24332–					
1	16:14405	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009707	MF-261
DOE/BP/35245–					
3	16:15335	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009693	MF-908
DOE/BP/35544–					
1	16:14792	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009690	MF-920
DOE/BP/39339–					
3	16:15333	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009702	MF-600
DOE/BP/60294–					
1	16:14793	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009691	MF-920
DOE/BP/64321–					
2	16:14404	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009705	MF-600
DOE/BP/64344–					
2	16:15291	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009709	MF-600
DOE/CE–					
0300P	16:14702	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008995	MF-330
DOE/CE/15397–					
T8	16:14087	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008974	MF-310
DOE/CE/15466–					
T1	16:14016	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009812	MF-350
DOE/CE/26579–					
T1	16:14866	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009993	MF-249
DOE/CE/40740–					
2	16:14385	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009792	MF-310

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/CE/40748–T1	16:14840	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007688	PC-310
DOE/CH/10332–1	16:14244	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009789	MF-721
DOE/CH/10402–8	16:14245	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010001	MF-820
DOE/CH/10406–T3	16:14670	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009618	PC-331
DOE/CR–0002-2/91	16:14722	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009066	MF-900
DOE/DP/40200–149-Vol.45	16:15924	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010027	MF-712
DOE/EA–0496-Vol.1	16:15292	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010636	MF-630
DOE/EH–002/0191-RCRA	16:14688	INIS; OSTI (Free of Charge)		TI91009387	MF-630
002/0191/CERCLA	16:14687	INIS; OSTI (Free of Charge)		TI91009391	MF-630
231-001/0490	16:14689	INIS; OSTI (Free of Charge)		TI91009390	MF-630
231-001/0990	16:14690	INIS; OSTI (Free of Charge)		TI91009392	MF-630
231-001/1190	16:14691	OSTI (Free of Charge)		TI91009393	MF-630
231-003/0191	16:14692	INIS; OSTI (Free of Charge)		TI91009388	MF-630
231-004/0191	16:14693	INIS; OSTI (Free of Charge)		TI91009389	MF-630
DOE/EIA–0109(91/03)	16:14089	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91010246	MF-950
0174(89)	16:14408	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91009827	MF-950
0226(91/03)	16:14736	OSTI; NTIS; GPO; INIS; GPO Dep.	E 1.99:	DE91009828	MF-950
0520(91/03)	16:14090	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91009882	MF-950
0538(90/91-24)	16:14729	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91009302	MF-950
0538(90/91-26)	16:14091	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91009861	MF-950
0538(90/91-27)	16:14092	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91010184	MF-950
0543(90/4Q)	16:14730	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91009881	MF-950
DOE/ER–0493T	16:15863	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010686	MF-420
DOE/ER/01545–445	16:15573	*See* DOE/ER/40423–13-P90			
DOE/ER/03072–64	16:15532	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010354	MF-414
DOE/ER/12031–T3	16:15336	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010194	MF-408
DOE/ER/13044–T4	16:15510	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010639	MF-410
DOE/ER/13262–7	16:15485	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010740	MF-411
DOE/ER/13263–7	16:14989	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009522	MF-401
DOE/ER/13291–6	16:15025	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009627	MF-406
DOE/ER/13442–5	16:14971	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010266	MF-412
DOE/ER/13451–5	16:14972	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009628	MF-401
DOE/ER/13492–T2	16:14990	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007982	MF-401
DOE/ER/13495–T4	16:15337	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009799	MF-408
DOE/ER/13496–5	16:15338	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009519	MF-408
DOE/ER/13500–T2	16:14973	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008840	MF-401
DOE/ER/13508–5	16:14994	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010603	MF-411
DOE/ER/13678–40	16:14964	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009521	MF-401
DOE/ER/13764–T2	16:15026	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009803	MF-406
DOE/ER/13965–3	16:14974	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010733	MF-411
DOE/ER/13970–2	16:15339	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010621	MF-408; MF-405

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/13974–					
T1	16:14975	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009873	MF-401
DOE/ER/18862–					
1	16:15925	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007120	MF-420
DOE/ER/40153–					
7	16:15571	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010749	MF-414
DOE/ER/40162–					
T5	16:15651	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010746	MF-413
DOE/ER/40224–					
158	16:15572	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009567	MF-414
DOE/ER/40365–					
4	16:15714	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010265	MF-413
DOE/ER/40368–					
T1	16:15533	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010397	MF-414
DOE/ER/40371–					
4	16:15521	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010702	MF-413
DOE/ER/40376–					
4	16:15652	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010739	MF-413
DOE/ER/40419–					
22	16:15534	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008910	MF-413
DOE/ER/40423–					
06-P90	16:15459	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009610	MF-414
13-P90	16:15573	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009613	MF-414
19	16:15460	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009790	MF-412
DOE/ER/40479–					
3	16:15535	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010641	MF-413
DOE/ER/40523–					
T3	16:15536	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010747	MF-414
DOE/ER/40526–					
1	16:15537	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010258	MF-414
DOE/ER/45265–					
4	16:14899	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010705	MF-410
DOE/ER/45308–					
4	16:14900	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009817	MF-404
DOE/ER/45315–					
15	16:14891	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009262	MF-404
DOE/ER/45388–					
1	16:14901	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009997	MF-404
DOE/ER/52161–					
T1	16:15926	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010729	MF-424
DOE/ER/53198–					
169	16:15877	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009679	PC-426
DOE/ER/53223–					
158	16:15878	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010730	MF-422
DOE/ER/53266–					
30	16:15879	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010421	MF-427
31	16:15880	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010422	MF-420
35	16:15881	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010423	MF-420
36	16:15882	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010424	MF-427
DOE/ER/53298–					
2	16:15883	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010261	MF-427
DOE/ER/53300–					
1	16:15884	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010264	MF-420
DOE/ER/54084–					
1	16:15927	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010263	MF-420
DOE/ER/54109–					
T1	16:15885	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010657	MF-420
DOE/ER/60406–					
T3	16:15340	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008274	MF-408
DOE/ER/60409–					
5	16:15352	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009592	MF-408
DOE/ER/60469–					
4	16:15435	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009633	MF-408
DOE/ER/60557–					
1	16:15269	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007575	MF-402
DOE/ER/60673–					
1	16:15341	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010307	MF-408
T1	16:15342	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009837	MF-408
DOE/ER/60868–					
2	16:14976	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009345	MF-401

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/60899–					
5	16:15348	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009258	MF-408
DOE/ER/60997–					
T1	16:15345	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009996	MF-408
DOE/ET/10815–					
139	16:14483	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009058	MF-112
155	16:14748	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010674	MF-112
DOE/ET/34212–					
58	16:14504	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91009104	PC-523
DOE/ET/51013–					
291	16:15886	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009794	MF-421
T238	16:15928	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009795	MF-405
T239	16:15929	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009796	MF-421
DOE/ET/53088–					
481	16:15887	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010878	MF-420
DOE/FE–					
0210P	16:14096	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009068	MF-126
0211P	16:14490	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008637	PC-101
0213P	16:14491	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008638	PC-101; PC-105
0216P	16:14484	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009355	MF-101
DOE/ID–					
10298	16:14623	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010061	MF-523
DOE/ID/12608–					
3-Vol.1	16:15355	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010644	MF-314
T1	16:15356	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010706	MF-314
T10	16:15362	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010712	MF-314
T2	16:15357	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010707	MF-314
T3	16:15358	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010708	MF-314
T4	16:15359	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010709	MF-314
T5	16:15360	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010710	MF-310
T6	16:15361	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010711	MF-310
DOE/ID/12693–					
1	16:14460	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009976	MF-257
DOE/ID/12826–					
1	16:14841	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009987	MF-310
DOE/ID/12882–					
1	16:14842	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009883	PC-310
DOE/IG–					
0294	16:14694	OSTI (Free of Charge)		TI91009677	PC-960
DOE/MC/11076–					
2952	16:14168	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002028	MF-123
DOE/MC/20037–					
2939	16:14051	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002027	MF-124
DOE/MC/23075–					
2973	16:13984	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002046	MF-109
2974	16:13985	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002056	MF-109
DOE/MC/23263–					
2877	16:14752	OSTI; NTIS; GPO Dep.	E 1.99:	DE90015338	PC-110
DOE/MC/23270–					
2969	16:14753	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002055	MF-110
DOE/MC/24266–					
2966	16:13948	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002052	MF-109
2978	16:13983	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002058	MF-109
DOE/MC/26367–					
2958	16:13949	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008912	MF-108
DOE/MC/27084–					
2960	16:14195	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002038	MF-123
DOE/METC–					
90-6115-Vol.2	16:13953	OSTI; NTIS; GPO Dep.	E 1.99:	DE90009690	MF-106; MF-109
90/6115-Vol.1	16:13952	OSTI; NTIS; GPO Dep.	E 1.99:	DE90009689	MF-106; MF-109
91/0273	16:13995	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002037	MF-106
DOE/NASA/50162–					
5	16:14843	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009678	PC-336
DOE/NE/34082–					
T16	16:14505	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008302	MF-523
T22	16:14506	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008308	MF-523
T23	16:14507	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008309	MF-523
T29	16:14508	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008322	MF-523

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
T36	16:14509	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008329	MF-523
T37	16:14510	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008330	MF-523
T38	16:14511	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008331	MF-523
T40	16:14512	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008333	MF-523
T47	16:14513	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008340	MF-523
T48	16:14514	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008341	MF-523
T49	16:14515	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008342	MF-523
T50	16:14516	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91008343	MF-523
T51	16:14517	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91009668	MF-523
DOE/NV–					
209-Rev.11	16:15214	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009062	MF-700
336	16:14331	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009376	MF-600
91009791	16:14246	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009791	MF-814
DOE/NV/10384–					
31	16:15293	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010370	MF-702
DOE/NV/10630–					
12	16:15270	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010587	MF-721
DOE/NV/10845–					
7	16:15294	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009218	MF-703
DOE/OSTI–					
3406-Suppl.2-Add.1	16:14247	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91000566	PC-814
DOE/PC/79796–					
T10	16:14492	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009499	MF-105
DOE/PC/79798–					
T10	16:14493	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008958	MF-105
DOE/PC/79876–					
T1	16:13954	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009480	MF-102
DOE/PC/79880–					
T1	16:14017	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009895	MF-102
T2	16:13935	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009896	MF-102
T3	16:13936	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009897	MF-102
T4	16:14018	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009898	MF-102
T5	16:14019	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009899	MF-102
T6	16:14020	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009900	MF-102
T7	16:14021	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009901	MF-102
DOE/PC/79915–					
T12	16:14025	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008417	PC-103
DOE/PC/79929–					
11	16:13996	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008953	MF-105
DOE/PC/88750–					
T5	16:14026	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008938	MF-104
DOE/PC/88800–					
34	16:13986	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008937	MF-108
DOE/PC/88812–					
T7	16:13955	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008364	MF-108
DOE/PC/88850–					
T2	16:14494	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007968	PC-105
DOE/PC/88874–					
T12	16:13997	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009505	MF-105
DOE/PC/88883–					
T8	16:13937	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008950	MF-102
DOE/PC/88885–					
T2	16:13938	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009493	MF-102
DOE/PC/88889–					
T7	16:14495	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009503	MF-105
DOE/PC/88891–					
T4	16:13956	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008358	MF-102
DOE/PC/88913–					
T8	16:15027	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008356	MF-103
DOE/PC/88916–					
T1	16:13957	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009497	MF-108
DOE/PC/88924–					
9	16:13987	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008355	MF-113
DOE/PC/88927–					
T5	16:13958	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009491	MF-106
DOE/PC/88935–					
T8	16:13959	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009507	MF-108
DOE/PC/88940–					
T6	16:13960	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008967	MF-108
DOE/PC/88947–					
T9	16:14022	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008947	MF-115

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DOE/PC/89658– T2	16:13961	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008365	MF-102
DOE/PC/89659– T2	16:13998	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008948	MF-102
DOE/PC/89663– T1	16:14485	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008530	MF-113
DOE/PC/89755– T2	16:14027	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008936	MF-102
DOE/PC/89760– T2	16:13962	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008943	MF-109
DOE/PC/89762– T2	16:13988	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008952	MF-113
DOE/PC/89764– T1	16:13989	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008484	MF-113
T2	16:13990	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008487	MF-113
DOE/PC/89772– T2	16:13963	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009501	MF-113
DOE/PC/89783– T1	16:13964	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009487	MF-108
DOE/PC/89786– T1	16:14399	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009808	MF-108
DOE/PC/89788– T2	16:13965	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009490	MF-108
T3	16:13966	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009489	MF-108
DOE/PC/89790– 5	16:13991	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008451	MF-105
DOE/PC/89793– T2	16:13992	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008944	MF-113
DOE/PC/89807– T2	16:13999	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008942	MF-106
DOE/PC/89867– T2	16:13967	OSTI; NTIS; GPO Dep.	E 1.99:	DE91005752	PC-108
DOE/PC/89903– T2	16:13968	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008946	MF-106
T3	16:13969	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009492	MF-106
DOE/PC/89908– T6	16:13939	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008949	MF-102
DOE/PC/89909– T4	16:13940	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008362	MF-113
DOE/PC/90013– T14	16:13970	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007497	PC-108
DOE/PC/90037– T2	16:13971	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008359	MF-113
T3	16:13972	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008528	MF-108
DOE/PC/90176– T13	16:14000	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010512	MF-102
DOE/PC/90177– T1	16:13941	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009485	MF-102
DOE/PC/90178– T1	16:13942	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008522	MF-113
DOE/PC/90274– T10	16:14750	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008935	MF-112
T9	16:14749	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008361	MF-112
DOE/PC/90293– T1	16:15221	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008534	MF-113
DOE/PC/90305– T1	16:14400	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008533	MF-108
DOE/PC/90309– 1	16:14001	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008450	MF-105
DOE/PC/90312– T1	16:13973	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008966	MF-105
DOE/PC/90504– T18	16:13974	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008896	MF-102
DOE/PC/91257– T7	16:13975	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008539	MF-102
DOE/PR– 0006	16:14679	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009746	MF-900
DOE/RL– 88-30-Rev.1-Vol.1	16:14248	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009364	MF-721
88-30-Rev.1-Vol.2	16:14249	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009413	MF-721
90-28	16:15222	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010103	MF-902

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90-38	16:14250	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009386	MF-721
91-06-Vol.1-Pt.1	16:14251	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010841	MF-630
91-06-Vol.1-Pt.2	16:14252	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010842	MF-630
91-06-Vol.2	16:14253	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010843	MF-630
91-06-Vol.3-Pt.1	16:14254	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010844	MF-630
91-06-Vol.3-Pt.2	16:14255	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010845	MF-630
91-06-Vol.4	16:14256	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010846	MF-630
DOE/SF/17170–					
T25	16:14751	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009292	MF-504
DOE/SF/18225–					
T1	16:14794	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009994	MF-350
DOE/SR/18035–					
P-H2	16:15295	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009822	MF-703
DOE/WIPP–					
91-012-Vol.2	16:14257	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009978	MF-721
DOL–					
91010192	16:14332	OSTI; NTIS		DE91010192	
DP-MS–					
86-217-Al-All	16:14258	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009339	MF-721
DPST–					
67-285	16:14624	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009998	MF-704
83-718-Rev.1	16:14625	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009309	MF-707
86-802	16:14626	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009312	MF-700
88-605	16:15296	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009304	MF-702
DTH-ISVA-PR–					
71	16:15048	OSTI; NTIS (US Sales Only)		DE91763368	
DTH-ISVA-Series Paper–					
49	16:15297	OSTI; NTIS (US Sales Only)		DE91763373	
DTH-LET-RE–					
89-4	16:14844	OSTI; NTIS (US Sales Only)		DE91763407	
DTH-LV-MEDD–					
215	16:14433	OSTI; NTIS (US Sales Only)		DE91763424	
216	16:14428	OSTI; NTIS (US Sales Only)		DE91763423	
DUN–					
6594-Del.	16:14607	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009220	MF-700
ECFA–					
90-133(v.1).	16:15526	*See* CERN–90-10(v.1)			
90-133(v.3).	16:15145	*See* CERN–90-10(v.3)			
ECN–					
90-013	16:14465	OSTI; NTIS (US Sales Only)		DE91760540	
ECN-C–					
90-1	16:14259	OSTI; NTIS (US Sales Only); INIS		DE91625099	
90-2	16:14260	OSTI; NTIS (US Sales Only); INIS		DE91625100	
90-034	16:15930	OSTI; NTIS (US Sales Only); INIS		DE91623770	
90-036	16:14261	OSTI; NTIS (US Sales Only); INIS		DE91625098	
90-039	16:15931	OSTI; NTIS (US Sales Only); INIS		DE91623782	
90-043	16:14965	OSTI; NTIS (US Sales Only); INIS		DE91625520	
90-051	16:14002	OSTI; NTIS (US Sales Only)		DE91760564	
90-053	16:14944	OSTI; NTIS (US Sales Only)		DE91760576	
90-054	16:14845	OSTI; NTIS (US Sales Only)		DE91760557	
90-055	16:14795	OSTI; NTIS (US Sales Only)		DE91760567	
90-059	16:14134	OSTI; NTIS (US Sales Only)		DE91760600	
90-061	16:14945	OSTI; NTIS (US Sales Only)		DE91760568	
91-002	16:14720	OSTI; NTIS (US Sales Only)		DE91760577	
ECN-I–					
90-037	16:15223	OSTI; NTIS (US Sales Only); INIS		DE91625734	
90-040	16:15932	OSTI; NTIS (US Sales Only); INIS		DE91625349	
90-047	16:15224	OSTI; NTIS (US Sales Only)		DE91760558	
91-006	16:14743	OSTI; NTIS (US Sales Only)		DE91760569	
ECN-R–					
90-007	16:15933	OSTI; NTIS (US Sales Only); INIS		DE91625342	
ECN-RX–					
90-031	16:14583	OSTI; NTIS (US Sales Only); INIS		DE91625930	
90-039	16:15715	OSTI; NTIS (US Sales Only); INIS		DE91625451	
90-041	16:15934	OSTI; NTIS (US Sales Only); INIS		DE91625343	
90-047	16:15935	OSTI; NTIS (US Sales Only); INIS		DE91625344	
90-051	16:15936	OSTI; NTIS (US Sales Only); INIS		DE91625345	
90-053	16:15937	OSTI; NTIS (US Sales Only); INIS		DE91625350	
90-056	16:15162	OSTI; NTIS (US Sales Only); INIS		DE91626029	
90-057	16:14608	OSTI; NTIS (US Sales Only); INIS		DE91626020	
90-062	16:15938	OSTI; NTIS (US Sales Only); INIS		DE91625351	

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90-074	16:14946	OSTI; NTIS (US Sales Only)		DE91760543	
90-076	16:15939	OSTI; NTIS (US Sales Only); INIS		DE91625346	
90-082	16:15225	OSTI; NTIS (US Sales Only)		DE91760566	
90-090	16:15197	OSTI; NTIS (US Sales Only)		DE91760544	
EFI-TR–					
3749	16:14723	OSTI; NTIS (US Sales Only)		DE91763503	
EGG–					
10617-1079	16:15226	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010484	MF-702
10617-1109	16:15199	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010769	MF-706
10617-411	16:15265	*See* UCRL-JC–105277			
10617-5039	16:15198	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010770	MF-706
10617-5072	16:15972	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91010772	MF-705
10617-5083	16:15973	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010826	MF-705
EGG-BNCT–					
8777-VOL.4-NO.12	16:15349	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010069	MF-507
9411-Vol.5-No.1	16:15350	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010051	MF-507
EGG-EAST–					
9382	16:14627	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010070	MF-520
EGG-ESQ–					
9293	16:15298	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010086	MF-502
9401	16:15227	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010085	MF-502
EGG-FSP–					
9435	16:15940	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91010078	MF-520
EGG-M–					
89348	16:14262	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010090	
89349	16:14263	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010091	
89512	16:15941	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010093	MF-423
90015	16:15001	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010089	MF-406
90056	16:14628	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010068	MF-520
90354	16:14629	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010067	MF-520
90364	16:15228	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010063	MF-605
90365	16:15028	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010079	MF-505
90397	16:15002	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010094	MF-820
90398	16:15003	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010082	MF-513
90413	16:15511	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010102	MF-505
90462	16:15974	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010092	MF-505; MF-506
90469	16:14902	OSTI; NTIS; GPO Dep.	E 1.99:	DE91006208	MF-401; MF-404
90541	16:15004	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010095	MF-820
90553	16:15229	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010058	MF-313
91009	16:14586	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010098	MF-528
91041	16:15050	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91010054	MF-520
91043	16:14630	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010055	MF-506
91103	16:14264	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010071	MF-512
EGG-MS–					
9254	16:14631	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010080	MF-520
EGG-NE–					
9087	16:14611	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91010050	MF-528
EGG-NERD–					
8585	16:14612	OSTI; NTIS (US Sales Only); INIS; GPO Dep.	E 1.99:	DE91010076	MF-528
EGG-WM–					
9090-Rev.1	16:14333	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010075	MF-510
9091	16:14334	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010099	MF-510
9299	16:14265	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010097	MF-510
9455	16:14335	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010062	MF-502
EGG-WTD–					
9387	16:15230	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010084	MF-510
9422	16:14336	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010026	MF-510
EML–					
523	16:15231	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009715	MF-402
529	16:15761	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009714	MF-407
EMO–					
1031	16:15385	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010126	MF-902
ENET–					
8700187/25	16:14796	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765824	
8700456/1	16:14797	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765830	
8900018/1	16:14798	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765857	

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8900027/2	16:14799	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765818	
8900056/2	16:14800	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765819	
8900079-1	16:14883	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765820	
8900091/4	16:14801	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765815	
8900094/2	16:14419	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765859	
8900112/1	16:14429	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765821	
8900154/1	16:14802	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765823	
8900171/1	16:14784	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765822	
8900176-1	16:14803	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765825	
8900257/1	16:14804	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765826	
8900257/2	16:14805	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765828	
8900388/1	16:15040	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765827	
8900434/1	16:14846	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765829	
8900448/1	16:14367	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765863	
8900459/1	16:14847	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765856	
8900514/1	16:14104	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765854	
8900597/1	16:14806	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765858	
89006733/1	16:14808	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765855	
8990001/1	16:14807	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765816	
8990021/1	16:14420	OSTI; NTIS (US Sales Only); ENET, Elfenauweg 29, Bern (CH)		DE91765817	
ETDE-mf–					
1764468	16:14849	OSTI; NTIS (US Sales Only)		DE91764468	
1764469	16:13944	OSTI; NTIS (US Sales Only)		DE91764469	
1764473	16:14466	OSTI; NTIS (US Sales Only)		DE91764473	
1764476	16:15436	OSTI; NTIS (US Sales Only)		DE91764476	
1764488	16:14023	OSTI; NTIS (US Sales Only)		DE91764488	
1764490	16:14430	OSTI; NTIS (US Sales Only)		DE91764490	
1764549	16:14046	OSTI; NTIS (US Sales Only)		DE91764549	
1764594	16:14009	OSTI; NTIS (US Sales Only)		DE91764594	
1764623	16:14731	OSTI; NTIS (US Sales Only)		DE91764623	
1764632	16:14695	OSTI; NTIS (US Sales Only)		DE91764632	
1764633	16:14377	OSTI; NTIS (US Sales Only)		DE91764633	
1764635	16:14378	OSTI; NTIS (US Sales Only)		DE91764635	
1764636	16:14966	OSTI; NTIS (US Sales Only)		DE91764636	
1764785	16:14732	OSTI; NTIS (US Sales Only)		DE91764785	
ETDE/NL-mf–					
1760528	16:14496	OSTI; NTIS (US Sales Only)		DE91760528	
1760541	16:14039	OSTI; NTIS (US Sales Only)		DE91760541	
1760542	16:14047	OSTI; NTIS (US Sales Only)		DE91760542	
ETSU-B–					
1180	16:14850	OSTI; NTIS (US Sales Only)		DE91763837	
1241	16:14395	OSTI; NTIS (US Sales Only)		DE91763836	
ETSU-SSH–					
4053	16:14401	OSTI; NTIS (US Sales Only)		DE91763838	
4073	16:14402	OSTI; NTIS (US Sales Only)		DE91763839	
ETSU-TID–					
4080	16:14464	OSTI; NTIS (US Sales Only)		DE91763840	
ETY–					
27/1990	16:14744	OSTI; NTIS (US Sales Only)		DE91763441	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
EUR–					
11660	16:14486	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; ECU $12.50		TI91009809	
11977	16:14851	OSTI; NTIS (US Sales Only)		TI91767670	
12097	16:14093	OSTI; NTIS (US Sales Only)		TI91762700	
12099	16:14867	OSTI; NTIS (US Sales Only)		TI91762709	
12107	16:14852	OSTI; NTIS (US Sales Only)		TI91762701	
12117	16:14467	OSTI; NTIS (US Sales Only)		TI91767652	
12157	16:14853	OSTI; NTIS (US Sales Only)		TI91762706	
12171	16:14854	OSTI; NTIS (US Sales Only)		TI91767668	
12283	16:14468	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 10		TI91008695	
12301	16:14855	OSTI; NTIS (US Sales Only)		TI91762710	
12345	16:14461	OSTI; NTIS (US Sales Only)		TI91767664	
12384	16:14469	OSTI; NTIS (US Sales Only)		TI91767651	
12464	16:15029	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91009233	
12591	16:14809	OSTI; NTIS (US Sales Only)		TI91767653	
12651	16:14015	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91006998	
12692	16:14370	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91009238	
12693	16:14368	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 5		TI91009241	
12712	16:14369	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91009242	
12713	16:14371	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91009237	
12716	16:14379	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91009236	
12717	16:15343	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91009244	
12740	16:14406	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91009247	
12742	16:14100	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 7.50		TI91009239	
12750	16:14421	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91009902	
12751	16:14470	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 7.50		TI91009245	
12752	16:14431	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 11.25		TI91009234	
12754	16:14426	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 5		TI91009235	
12755	16:14422	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91009886	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
EUR–					
12772	16:14995	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg; Price: ECU 21.25		TI91009240	
12805	16:14372	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91009246	
12859	16:14876	OSTI; NTIS (US Sales Only); Office for Official Publications of the European Communities, 2, rue Mercier, L-2985 Luxembourg		TI91009925	
FEI–					
0236.	16:15668	*See* INDC(CCP)–323/L			
1903	16:15804	OSTI; NTIS (US Sales Only); INIS		DE91623605	
1984	16:15762	OSTI; NTIS (US Sales Only); INIS		DE91623951	
1985	16:15763	OSTI; NTIS (US Sales Only); INIS		DE91623958	
2012	16:15109	OSTI; NTIS (US Sales Only); INIS		DE91624872	
2019	16:14538	OSTI; NTIS (US Sales Only); INIS		DE91624993	
2022	16:15110	OSTI; NTIS (US Sales Only); INIS		DE91624912	
2059	16:15716	OSTI; NTIS (US Sales Only); INIS		DE91624010	
FMPC–					
2220	16:14337	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008843	MF-700
FMPC/Sub–					
028	16:14338	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009927	MF-702
FNAL-TM–					
1380	16:15112	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009983	PC-414
1722	16:15956	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010324	PC-414
1731	16:15113	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010912	PC-414
FNAL/C–					
90/255-E	16:15538	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010308	MF-414
91/56-A	16:15461	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009670	MF-412
91/66-E	16:15539	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010309	MF-414
91/69	16:15111	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010328	MF-414
91/72-T	16:15574	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009769	MF-414
91/79	16:15138	*See* SSCL–372			
91/81-A	16:15540	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010353	PC-414
FRCEA-TH–					
308	16:14947	OSTI; NTIS (US Sales Only)		DE91767829	
326	16:15676	OSTI; NTIS (US Sales Only)		DE91762837	
FRCR–					
357	16:15879	*See* DOE/ER/53266–30			
358	16:15880	*See* DOE/ER/53266–31			
380	16:15881	*See* DOE/ER/53266–35			
381	16:15882	*See* DOE/ER/53266–36			
FRNC-TH–					
3691	16:15030	OSTI; NTIS (US Sales Only)		DE91762836	
GA-A–					
20362	16:15888	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010696	PC-420
20363	16:15889	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010697	PC-420
GA-C–					
20285	16:15890	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009814	MF-420
GKSS–					
90/E/17	16:15299	OSTI; NTIS (US Sales Only)		DE91764471	
GSF–					
17/90	16:15271	OSTI; NTIS (US Sales Only); INIS		DE91765001	
GSI–					
90-28	16:15486	OSTI; NTIS (US Sales Only); INIS		DE91764639	
90-29	16:15073	OSTI; NTIS (US Sales Only); INIS		DE91764933	
90-73(prepr.)	16:15698	OSTI; NTIS (US Sales Only); INIS		DE91764565	
91-01(prepr.)	16:15487	OSTI; NTIS (US Sales Only); INIS		DE91764564	
91-02(prepr.)	16:15717	OSTI; NTIS (US Sales Only); INIS		DE91764563	
91-03	16:15653	OSTI; NTIS (US Sales Only); INIS		DE91764932	
91-03(prepr.)	16:15654	OSTI; NTIS (US Sales Only); INIS		DE91764670	
91-08(prepr.)	16:15700	OSTI; NTIS (US Sales Only); INIS		DE91764946	
91-09(prepr.)	16:15718	OSTI; NTIS (US Sales Only); INIS		DE91764945	
HASL–					
300-Ed.27-Vol.1	16:15232	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010178	MF-400
HIFAN–					
478	16:15948	*See* LBL–29743			
HLRZ–					
90-080	16:15614	*See* DESY–90-118			
90-101	16:15617	*See* DESY–90-159			

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HW–					
41677	16:14632	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008663	MF-707
64966	16:14633	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009384	MF-520
66454	16:14609	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009425	MF-520
81868	16:14266	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009598	MF-711
HY/FL-JULK–					
5	16:14680	OSTI; NTIS (US Sales Only)		DE91763432	
IAE–					
4670-16	16:15975	OSTI; NTIS (US Sales Only); INIS		DE91625149	
4679-11	16:15114	OSTI; NTIS (US Sales Only); INIS		DE91624913	
4725-1	16:15575	OSTI; NTIS (US Sales Only); INIS		DE91623903	
4749-15	16:14587	OSTI; NTIS (US Sales Only); INIS		DE91624960	
4760-1	16:15488	OSTI; NTIS (US Sales Only); INIS		DE91623547	
4818-2	16:15541	OSTI; NTIS (US Sales Only); INIS		DE91623931	
4829-2	16:15702	OSTI; NTIS (US Sales Only); INIS		DE91624165	
4844-2	16:15542	OSTI; NTIS (US Sales Only); INIS		DE91623944	
4854-1	16:15719	OSTI; NTIS (US Sales Only); INIS		DE91625426	
4944-1	16:15805	OSTI; NTIS (US Sales Only); INIS		DE91623659	
4948-1	16:15618	OSTI; NTIS (US Sales Only); INIS		DE91623503	
4968-14	16:15764	OSTI; NTIS (US Sales Only); INIS		DE91623952	
4992-8	16:15942	OSTI; NTIS (US Sales Only); INIS		DE91623766	
IAEA-INFCIRC–					
385(Add.1)	16:16029	OSTI; NTIS (US Sales Only); INIS		DE91625118	
389	16:14351	OSTI; NTIS (US Sales Only); INIS		DE91625119	
390	16:14888	OSTI; NTIS (US Sales Only); INIS		DE91626178	
9(Rev.2/Add.8)	16:16028	OSTI; NTIS (US Sales Only); INIS		DE91625126	
IAEA-NDS–					
0(Rev.90/9)	16:16003	OSTI; NTIS (US Sales Only); INIS		DE91625142	
1(Rev.5)	16:16004	OSTI; NTIS (US Sales Only); INIS		DE91625127	
10(Rev.2)	16:15655	OSTI; NTIS (US Sales Only); INIS		DE91624088	
100(Rev.3)	16:16012	OSTI; NTIS (US Sales Only); INIS		DE91625128	
103(Rev.89/1)	16:16013	OSTI; NTIS (US Sales Only); INIS		DE91626179	
104(Rev.0)	16:15724	OSTI; NTIS (US Sales Only); INIS		DE91623967	
107(Rev.4)	16:16014	OSTI; NTIS (US Sales Only); INIS		DE91625129	
109(Rev.90/2)	16:16015	OSTI; NTIS (US Sales Only); INIS		DE91625130	
11(Rev.5)	16:15656	OSTI; NTIS (US Sales Only); INIS		DE91624089	
110(Rev.2)	16:16016	OSTI; NTIS (US Sales Only); INIS		DE91625131	
112(Rev.0)	16:15782	OSTI; NTIS (US Sales Only); INIS		DE91624790	
113(Rev.0)	16:16017	OSTI; NTIS (US Sales Only); INIS		DE91625132	
117(Rev.0)	16:15663	OSTI; NTIS (US Sales Only); INIS		DE91624090	
118(Rev.0)	16:15664	OSTI; NTIS (US Sales Only); INIS		DE91624091	
119(Rev.0)	16:16018	OSTI; NTIS (US Sales Only); INIS		DE91625133	
120(Rev.0)	16:15665	OSTI; NTIS (US Sales Only); INIS		DE91624092	
121(Rev.0)	16:15767	OSTI; NTIS (US Sales Only); INIS		DE91623953	
122(Rev.0)	16:16019	OSTI; NTIS (US Sales Only); INIS		DE91625134	
123(Rev.0)	16:15707	OSTI; NTIS (US Sales Only); INIS		DE91624166	
125(Rev.0)	16:15666	OSTI; NTIS (US Sales Only); INIS		DE91624093	
13(Rev.5)	16:15703	OSTI; NTIS (US Sales Only); INIS		DE91624167	
141(Rev.0)	16:15667	OSTI; NTIS (US Sales Only); INIS		DE91624094	
18(Rev.4)	16:15657	OSTI; NTIS (US Sales Only); INIS		DE91624095	
21(Rev.4)	16:15658	OSTI; NTIS (US Sales Only); INIS		DE91624096	
29(Rev.2)	16:16005	OSTI; NTIS (US Sales Only); INIS		DE91625135	
58(Rev.2)	16:15489	OSTI; NTIS (US Sales Only); INIS		DE91623573	
62(Rev.0)	16:15704	OSTI; NTIS (US Sales Only); INIS		DE91624168	
64(Rev.0)	16:15659	OSTI; NTIS (US Sales Only); INIS		DE91624097	
65(Rev.0)	16:16006	OSTI; NTIS (US Sales Only); INIS		DE91625136	
67(Rev.0)	16:15694	OSTI; NTIS (US Sales Only); INIS		DE91624127	
68(Rev.0)	16:15660	OSTI; NTIS (US Sales Only); INIS		DE91624098	
69(Rev.0)	16:16007	OSTI; NTIS (US Sales Only); INIS		DE91625137	
70(Rev.0)	16:16008	OSTI; NTIS (US Sales Only); INIS		DE91625138	
76(Rev.3)	16:16009	OSTI; NTIS (US Sales Only); INIS		DE91625139	
78(Rev.0)	16:16010	OSTI; NTIS (US Sales Only); INIS		DE91625140	
79(Rev.1)	16:15976	OSTI; NTIS (US Sales Only); INIS		DE91625150	
81(Rev.0)	16:15977	OSTI; NTIS (US Sales Only); INIS		DE91625151	
82(Rev.0)	16:15978	OSTI; NTIS (US Sales Only); INIS		DE91625152	
83(Rev.1)	16:15979	OSTI; NTIS (US Sales Only); INIS		DE91625153	
84(Rev.0)	16:15980	OSTI; NTIS (US Sales Only); INIS		DE91625154	
85(Rev.0)	16:16011	OSTI; NTIS (US Sales Only); INIS		DE91625141	
86(Rev.0)	16:15677	OSTI; NTIS (US Sales Only); INIS		DE91624106	
87(Rev.2)	16:15678	OSTI; NTIS (US Sales Only); INIS		DE91624107	
88(Rev.2)	16:15683	OSTI; NTIS (US Sales Only); INIS		DE91624111	

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IAEA-NDS–					
89(Rev.0)	16:15765	OSTI; NTIS (US Sales Only); INIS		DE91623959	
90(Rev.3)	16:15661	OSTI; NTIS (US Sales Only); INIS		DE91624099	
91(Rev.0)	16:15705	OSTI; NTIS (US Sales Only); INIS		DE91624169	
92(Rev.0)	16:15662	OSTI; NTIS (US Sales Only); INIS		DE91624100	
93(Rev.0)	16:15720	OSTI; NTIS (US Sales Only); INIS		DE91625452	
94(Rev.0)	16:15721	OSTI; NTIS (US Sales Only); INIS		DE91625427	
95(Rev.0)	16:15722	OSTI; NTIS (US Sales Only); INIS		DE91624011	
97(Rev.1)	16:15766	OSTI; NTIS (US Sales Only); INIS		DE91625421	
98(Rev.1)	16:15706	OSTI; NTIS (US Sales Only); INIS		DE91624170	
99(Rev.0)	16:15723	OSTI; NTIS (US Sales Only); INIS		DE91625453	
IAEA-TECDOC–					
576	16:15363	OSTI; NTIS (US Sales Only); INIS		DE91624594	
586	16:14518	OSTI; NTIS (US Sales Only); INIS		DE91625970	
587	16:14991	OSTI; NTIS (US Sales Only); INIS		DE91625550	
588	16:14267	OSTI; NTIS (US Sales Only); INIS		DE91625104	
589	16:16030	OSTI; NTIS (US Sales Only); INIS		DE91626176	
IAEA-WMRA–					
20	16:14268	OSTI; NTIS (US Sales Only); INIS		DE91625089	
IC–					
90/111	16:15832	OSTI; NTIS (US Sales Only); INIS		DE91625182	
90/170	16:15833	OSTI; NTIS (US Sales Only); INIS		DE91625183	
90/208	16:15619	OSTI; NTIS (US Sales Only); INIS		DE91625215	
90/212	16:15576	OSTI; NTIS (US Sales Only); INIS		DE91625395	
90/214	16:15462	OSTI; NTIS (US Sales Only); INIS		DE91625352	
90/225	16:15834	OSTI; NTIS (US Sales Only); INIS		DE91625184	
90/226	16:15452	OSTI; NTIS (US Sales Only); INIS		DE91625181	
90/235	16:15620	OSTI; NTIS (US Sales Only); INIS		DE91625216	
90/249	16:15835	OSTI; NTIS (US Sales Only); INIS		DE91625207	
90/254	16:15806	OSTI; NTIS (US Sales Only); INIS		DE91625257	
90/257	16:15836	OSTI; NTIS (US Sales Only); INIS		DE91625185	
90/259	16:15807	OSTI; NTIS (US Sales Only); INIS		DE91625258	
90/260	16:15808	OSTI; NTIS (US Sales Only); INIS		DE91625259	
90/271	16:15577	OSTI; NTIS (US Sales Only); INIS		DE91625400	
90/275	16:15837	OSTI; NTIS (US Sales Only); INIS		DE91625186	
90/278	16:15621	OSTI; NTIS (US Sales Only); INIS		DE91625217	
90/288	16:15838	OSTI; NTIS (US Sales Only); INIS		DE91625208	
90/292	16:15839	OSTI; NTIS (US Sales Only); INIS		DE91625187	
90/293	16:15809	OSTI; NTIS (US Sales Only); INIS		DE91625260	
90/294	16:15810	OSTI; NTIS (US Sales Only); INIS		DE91625261	
90/295	16:15233	OSTI; NTIS (US Sales Only); INIS		DE91625733	
90/297	16:15578	OSTI; NTIS (US Sales Only); INIS		DE91625381	
90/298	16:14948	OSTI; NTIS (US Sales Only); INIS		DE91625673	
90/299	16:15840	OSTI; NTIS (US Sales Only); INIS		DE91625188	
90/300	16:15490	OSTI; NTIS (US Sales Only); INIS		DE91625242	
90/301	16:15841	OSTI; NTIS (US Sales Only); INIS		DE91625189	
90/307	16:15842	OSTI; NTIS (US Sales Only); INIS		DE91625209	
90/308	16:15491	OSTI; NTIS (US Sales Only); INIS		DE91625243	
90/309	16:15492	OSTI; NTIS (US Sales Only); INIS		DE91625244	
90/310	16:15493	OSTI; NTIS (US Sales Only); INIS		DE91625245	
90/311	16:15494	OSTI; NTIS (US Sales Only); INIS		DE91625246	
90/312	16:15843	OSTI; NTIS (US Sales Only); INIS		DE91625192	
90/313	16:15844	OSTI; NTIS (US Sales Only); INIS		DE91625193	
90/314	16:15811	OSTI; NTIS (US Sales Only); INIS		DE91625262	
90/315	16:15845	OSTI; NTIS (US Sales Only); INIS		DE91625194	
90/316	16:15463	OSTI; NTIS (US Sales Only); INIS		DE91625368	
90/317	16:15464	OSTI; NTIS (US Sales Only); INIS		DE91625369	
90/318	16:15465	OSTI; NTIS (US Sales Only); INIS		DE91625370	
90/319	16:15846	OSTI; NTIS (US Sales Only); INIS		DE91625195	
90/327	16:14361	OSTI; NTIS (US Sales Only); INIS		DE91625861	
90/334	16:15847	OSTI; NTIS (US Sales Only); INIS		DE91625210	
90/337	16:15579	OSTI; NTIS (US Sales Only); INIS		DE91625401	
90/341	16:15848	OSTI; NTIS (US Sales Only); INIS		DE91625190	
90/349	16:15580	OSTI; NTIS (US Sales Only); INIS		DE91625414	
90/352	16:15812	OSTI; NTIS (US Sales Only); INIS		DE91625263	
90/360	16:14977	OSTI; NTIS (US Sales Only); INIS		DE91625523	
90/368	16:14978	OSTI; NTIS (US Sales Only); INIS		DE91625524	
90/70	16:15831	OSTI; NTIS (US Sales Only); INIS		DE91625191	
IFE/KR/E–					
90/001	16:14603	OSTI; NTIS (US Sales Only); INIS		DE91624996	
IFP–					
38321	16:14979	OSTI; NTIS (US Sales Only)		DE91762735	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
IFSR–					
481	16:15887	*See* DOE/ET/53088–481			
IFVE-OEA-OP-OKU–					
89-128	16:15115	OSTI; NTIS (US Sales Only); INIS		DE91625891	
IFVE-OEF–					
89-54	16:15543	OSTI; NTIS (US Sales Only); INIS		DE91623945	
IFVE-OEF-OEIUNK–					
89-192	16:15581	OSTI; NTIS (US Sales Only); INIS		DE91625396	
IFVE-OEIUNK–					
89-200	16:15582	OSTI; NTIS (US Sales Only); INIS		DE91623904	
IFVE-OKU–					
89-168	16:15116	OSTI; NTIS (US Sales Only); INIS		DE91624878	
IFVE-ONF–					
89-82	16:15117	OSTI; NTIS (US Sales Only); INIS		DE91624914	
89-98	16:15163	OSTI; NTIS (US Sales Only); INIS		DE91626074	
IFVE-OP–					
89-188	16:15119	OSTI; NTIS (US Sales Only); INIS		DE91624915	
89-191	16:15120	OSTI; NTIS (US Sales Only); INIS		DE91624873	
89-77	16:15118	OSTI; NTIS (US Sales Only); INIS		DE91624916	
IFVE-ORI–					
89-145	16:15768	OSTI; NTIS (US Sales Only); INIS		DE91623960	
IFVE-ORI-ONF-OEIUNK–					
89-221	16:15164	OSTI; NTIS (US Sales Only); INIS		DE91626063	
IFVE-OTF–					
89-118	16:15849	OSTI; NTIS (US Sales Only); INIS		DE91623492	
89-142	16:15850	OSTI; NTIS (US Sales Only); INIS		DE91623493	
89-143	16:15851	OSTI; NTIS (US Sales Only); INIS		DE91623494	
89-175	16:15583	OSTI; NTIS (US Sales Only); INIS		DE91623905	
89-176	16:15622	OSTI; NTIS (US Sales Only); INIS		DE91623504	
89-193	16:15852	OSTI; NTIS (US Sales Only); INIS		DE91623480	
89-204	16:15623	OSTI; NTIS (US Sales Only); INIS		DE91623505	
89-216	16:15584	OSTI; NTIS (US Sales Only); INIS		DE91623906	
IFVE-OUNK–					
89-113	16:15031	OSTI; NTIS (US Sales Only); INIS		DE91623865	
89-124	16:15090	OSTI; NTIS (US Sales Only); INIS		DE91624830	
89-163	16:15146	OSTI; NTIS (US Sales Only); INIS		DE91624935	
89-182	16:15147	OSTI; NTIS (US Sales Only); INIS		DE91624936	
89-186	16:15148	OSTI; NTIS (US Sales Only); INIS		DE91624937	
89-187	16:15121	OSTI; NTIS (US Sales Only); INIS		DE91624879	
89-189	16:15122	OSTI; NTIS (US Sales Only); INIS		DE91624917	
INDC(AUS)–					
12/G(Ver.1).	16:15677	*See* IAEA-NDS–86(Rev.0)			
INDC(CCP)–					
323/L	16:15668	OSTI; NTIS (US Sales Only); INIS		DE91624101	
INDC(CUB)–					
004/L	16:15725	OSTI; NTIS (US Sales Only); INIS		DE91625454	
INDC(NDS)–					
238/L	16:15726	OSTI; NTIS (US Sales Only); INIS		DE91624012	
INIS-GB–					
336	16:15234	OSTI; NTIS (US Sales Only); INIS		DE91624623	
345	16:15959	OSTI; NTIS (US Sales Only); INIS		DE91626188	
INIS-SU–					
231	16:14573	OSTI; NTIS (US Sales Only); INIS		DE91003076	
232	16:15453	OSTI; NTIS (US Sales Only); INIS		DE91003077	
233	16:15454	OSTI; NTIS (US Sales Only); INIS		DE91003083	
234	16:15455	OSTI; NTIS (US Sales Only); INIS		DE91003090	
235	16:15981	OSTI; NTIS (US Sales Only); INIS		DE91003084	
237	16:15456	OSTI; NTIS (US Sales Only); INIS		DE91003081	
237/A	16:15741	OSTI; NTIS (US Sales Only); INIS		DE91003078	
238/A	16:15892	OSTI; NTIS (US Sales Only); INIS		DE91003082	
239	16:15457	OSTI; NTIS (US Sales Only); INIS		DE91003091	
240	16:15864	OSTI; NTIS (US Sales Only); INIS		DE91003079	
241	16:15962	OSTI; NTIS (US Sales Only); INIS		DE91003080	
INIS-XN–					
306	16:14286	OSTI; NTIS (US Sales Only); INIS		DE91625105	
INIS-mf–					
12181	16:15960	OSTI; NTIS (US Sales Only); INIS		DE91764342	
12182	16:14519	OSTI; NTIS (US Sales Only); INIS		DE91764345	
12186	16:14903	OSTI; NTIS (US Sales Only); INIS		DE91769178	
12187	16:14269	OSTI; NTIS (US Sales Only); INIS		DE91768990	
12797	16:15770	OSTI; NTIS (US Sales Only); INIS		DE91625422	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
12798	16:15891	OSTI; NTIS (US Sales Only); INIS		DE91623712	
12803	16:15961	OSTI; NTIS (US Sales Only); INIS		DE91625178	
12804	16:15962	OSTI; NTIS (US Sales Only); INIS		DE91625179	
12805	16:14499	OSTI; NTIS (US Sales Only); INIS		DE91755883	
12806	16:14707	OSTI; NTIS (US Sales Only); INIS		DE91626129	
12807	16:14196	OSTI; NTIS (US Sales Only); INIS		DE91625698	
INP–					
1353/PS	16:15173	OSTI; NTIS (US Sales Only); INIS		DE91626035	
INS–					
813	16:15544	OSTI; NTIS (US Sales Only); INIS		DE91767869	
855	16:15679	OSTI; NTIS (US Sales Only); INIS		DE91767893	
860	16:15625	OSTI; NTIS (US Sales Only); INIS		DE91767972	
862	16:15545	OSTI; NTIS (US Sales Only); INIS		DE91767971	
INS-T–					
499	16:15123	OSTI; NTIS (US Sales Only); INIS		DE91767866	
500	16:15079	OSTI; NTIS (US Sales Only); INIS		DE91767894	
IPF–					
89-1	16:15902	OSTI; NTIS (US Sales Only); INIS		DE91764560	
IPNO-DRE–					
8946	16:15745	OSTI; NTIS (US Sales Only)		DE91767820	
9005	16:15688	OSTI; NTIS (US Sales Only)		DE91767791	
9006	16:15746	OSTI; NTIS (US Sales Only)		DE91767821	
9008	16:15747	OSTI; NTIS (US Sales Only)		DE91767804	
9009	16:15684	OSTI; NTIS (US Sales Only)		DE91767803	
IPP–					
1/254	16:15903	OSTI; NTIS (US Sales Only); INIS		DE91764558	
5/33	16:15904	OSTI; NTIS (US Sales Only); INIS		DE91764701	
III/160	16:15905	OSTI; NTIS (US Sales Only); INIS		DE91764559	
III/168	16:15945	OSTI; NTIS (US Sales Only); INIS		DE91764557	
IS-T–					
1490	16:14410	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010181	MF-401
1506	16:15816	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009867	MF-410
1524	16:14949	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007520	MF-404
1528	16:14967	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009868	MF-401
1532	16:14982	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009866	MF-401
ITEF–					
117-89	16:15680	OSTI; NTIS (US Sales Only); INIS		DE91624108	
125-89	16:15696	OSTI; NTIS (US Sales Only); INIS		DE91624129	
131-89	16:15546	OSTI; NTIS (US Sales Only); INIS		DE91623946	
138-89	16:15748	OSTI; NTIS (US Sales Only); INIS		DE91624028	
143-89	16:15590	OSTI; NTIS (US Sales Only); INIS		DE91623910	
158-89	16:15080	OSTI; NTIS (US Sales Only); INIS		DE91625881	
159-89	16:15681	OSTI; NTIS (US Sales Only); INIS		DE91624109	
167-89	16:15671	OSTI; NTIS (US Sales Only); INIS		DE91624104	
171-89	16:15906	OSTI; NTIS (US Sales Only); INIS		DE91623725	
180-89	16:15466	OSTI; NTIS (US Sales Only); INIS		DE91623795	
182-89	16:15467	OSTI; NTIS (US Sales Only); INIS		DE91623796	
ITEP–					
101-89	16:15626	OSTI; NTIS (US Sales Only); INIS		DE91623507	
112-89	16:15627	OSTI; NTIS (US Sales Only); INIS		DE91625218	
126-89	16:15591	OSTI; NTIS (US Sales Only); INIS		DE91623911	
133-89	16:15853	OSTI; NTIS (US Sales Only); INIS		DE91623495	
134-89	16:15612	OSTI; NTIS (US Sales Only); INIS		DE91623544	
144-89	16:15628	OSTI; NTIS (US Sales Only); INIS		DE91623508	
145-88	16:15749	OSTI; NTIS (US Sales Only); INIS		DE91623969	
146-89	16:15629	OSTI; NTIS (US Sales Only); INIS		DE91623509	
148-89	16:15854	OSTI; NTIS (US Sales Only); INIS		DE91623481	
151-89	16:15697	OSTI; NTIS (US Sales Only); INIS		DE91624130	
154-89	16:15630	OSTI; NTIS (US Sales Only); INIS		DE91623510	
155-89	16:15631	OSTI; NTIS (US Sales Only); INIS		DE91625219	
161-89	16:15632	OSTI; NTIS (US Sales Only); INIS		DE91623511	
163-89	16:15855	OSTI; NTIS (US Sales Only); INIS		DE91623482	
166-89	16:15633	OSTI; NTIS (US Sales Only); INIS		DE91623512	
169-89	16:15592	OSTI; NTIS (US Sales Only); INIS		DE91623912	
172-89	16:15593	OSTI; NTIS (US Sales Only); INIS		DE91623913	
173-89	16:15634	OSTI; NTIS (US Sales Only); INIS		DE91623513	
174-89	16:15594	OSTI; NTIS (US Sales Only); INIS		DE91623914	
IVL-B–					
989	16:15304	OSTI; NTIS (US Sales Only)		DE91763545	
IVO-A–					
04/90	16:15238	OSTI; NTIS (US Sales Only)		DE91763450	

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IVO-B–					
05/90	16:14810	OSTI; NTIS (US Sales Only)		DE91763449	
06/90	16:14010	OSTI; NTIS (US Sales Only)		DE91763448	
07/90	16:14856	OSTI; NTIS (US Sales Only)		DE91763455	
IYaF–					
88-142	16:15496	OSTI; NTIS (US Sales Only); INIS		DE91623549	
89-129	16:15775	OSTI; NTIS (US Sales Only); INIS		DE91623962	
89-31	16:15635	OSTI; NTIS (US Sales Only); INIS		DE91623514	
89-92	16:15497	OSTI; NTIS (US Sales Only); INIS		DE91623550	
89-93	16:15856	OSTI; NTIS (US Sales Only); INIS		DE91625196	
JAB–					
10733-TM3	16:15444	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009513	MF-703
JAERI-M–					
90-191	16:14907	OSTI; NTIS (US Sales Only); INIS		DE91767892	
90-201	16:15983	OSTI; NTIS (US Sales Only); INIS		DE91767875	
90-202	16:14640	OSTI; NTIS (US Sales Only); INIS		DE91767876	
90-203	16:15776	OSTI; NTIS (US Sales Only); INIS		DE91767973	
90-205	16:14502	OSTI; NTIS (US Sales Only); INIS		DE91767887	
90-207	16:14588	OSTI; NTIS (US Sales Only); INIS		DE91767863	
90-208	16:14287	OSTI; NTIS (US Sales Only); INIS		DE91767877	
90-209	16:14522	OSTI; NTIS (US Sales Only); INIS		DE91767888	
90-213	16:15777	OSTI; NTIS (US Sales Only); INIS		DE91767864	
90-216	16:14950	OSTI; NTIS (US Sales Only); INIS		DE91767906	
90-217	16:15239	OSTI; NTIS (US Sales Only); INIS		DE91767923	
90-218	16:16021	OSTI; NTIS (US Sales Only); INIS		DE91767905	
90-227	16:15008	OSTI; NTIS (US Sales Only); INIS		DE91767924	
JET-R–					
90-05	16:15907	OSTI; NTIS (US Sales Only); INIS		DE91623716	
JINR-R–					
2-89-533	16:15857	OSTI; NTIS (US Sales Only); INIS		DE91623483	
JTI–					
115	16:14373	OSTI; NTIS (US Sales Only)		DE91763535	
116	16:14394	OSTI; NTIS (US Sales Only)		DE91763536	
120	16:14374	OSTI; NTIS (US Sales Only)		DE91763537	
90	16:14383	*See* STEV-AVF–90-2			
Juel–					
2380	16:14929	OSTI; NTIS (US Sales Only); INIS		DE91769004	
2401	16:14288	OSTI; NTIS (US Sales Only); INIS		DE91764960	
2402	16:15124	OSTI; NTIS (US Sales Only); INIS		DE91769003	
2411	16:14526	OSTI; NTIS (US Sales Only); INIS		DE91764962	
K/CSD/TM–					
97	16:16022	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010431	MF-900
K/DSRD–					
263/R1	16:15204	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009111	
461	16:16023	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91010677	MF-700
K/QT–					
394-Pt.1	16:14289	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009877	MF-510
KAPL–					
4721	16:15778	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010692	PC-505
4723	16:14576	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010213	PC-505; PC-520
4724	16:15779	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010214	PC-505; PC-520
KCP–					
613-4184	16:14968	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008159	PC-701
KEK–					
90-3	16:15125	OSTI; NTIS (US Sales Only); INIS		DE91768091	
90-5	16:15126	OSTI; NTIS (US Sales Only); INIS		DE91768093	
90-8	16:15636	OSTI; NTIS (US Sales Only); INIS		DE91767862	
90-14	16:15091	OSTI; NTIS (US Sales Only); INIS		DE91767925	
KFK–					
4266	16:14908	OSTI; NTIS (US Sales Only); INIS		DE91764552	
4432	16:15127	OSTI; NTIS (US Sales Only); INIS		DE91764706	
4474	16:15128	OSTI; NTIS (US Sales Only); INIS		DE91764705	
4783	16:14951	OSTI; NTIS (US Sales Only); INIS		DE91764470	
4790	16:15946	OSTI; NTIS (US Sales Only); INIS		DE91764474	
4803	16:15174	OSTI; NTIS (US Sales Only); INIS		DE91764714	
4820	16:15032	OSTI; NTIS (US Sales Only); INIS		DE91764956	
4823	16:14909	OSTI; NTIS (US Sales Only); INIS		DE91769169	
4826	16:14523	OSTI; NTIS (US Sales Only); INIS		DE91765027	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
KFTI–					
89-1	16:15092	OSTI; NTIS (US Sales Only); INIS		DE91624831	
89-2	16:15479	OSTI; NTIS (US Sales Only); INIS		DE91624481	
89-3	16:15908	OSTI; NTIS (US Sales Only); INIS		DE91623756	
89-4	16:15093	OSTI; NTIS (US Sales Only); INIS		DE91624832	
89-5	16:15094	OSTI; NTIS (US Sales Only); INIS		DE91624833	
89-6	16:15149	OSTI; NTIS (US Sales Only); INIS		DE91624938	
89-7	16:15095	OSTI; NTIS (US Sales Only); INIS		DE91624834	
89-9	16:15909	OSTI; NTIS (US Sales Only); INIS		DE91623738	
89-10	16:15910	OSTI; NTIS (US Sales Only); INIS		DE91623737	
KI–					
90-6	16:14910	OSTI; NTIS (US Sales Only)		DE91763543	
KTM/E-B–					
75	16:14738	OSTI; NTIS (US Sales Only)		DE91763440	
KTM/E-D–					
184	16:14811	OSTI; NTIS (US Sales Only)		DE91763439	
186	16:15240	OSTI; NTIS (US Sales Only)		DE91763438	
LA–					
11584-MS	16:14348	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009850	MF-700
11798-M	16:15272	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010691	PC-814
11869-MS	16:15215	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009848	MF-700; MF-900
11888-MS	16:15217	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009859	PC-700; PC-900
11889-MS-Vol.2	16:14012	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009768	
11898-MS	16:15205	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009845	PC-700
11921-MS	16:15206	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009844	PC-700; PC-900
11958-MS	16:15984	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010180	
11997-MS	16:15427	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010482	PC-407
12042-MS	16:15216	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009529	MF-721; MF-903
LA-UR–					
90-2884	16:15346	OSTI; NTIS; GPO Dep.	E 1.99:	DE90016440	MF-408
90-3000	16:15780	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009371	MF-900
90-3050	16:15573	*See* DOE/ER/40423–13-P90			
90-3383	16:15512	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002309	MF-705
90-4168	16:15985	OSTI; NTIS; GPO Dep.	E 1.99:	DE91005895	MF-905
91-3	16:15672	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007348	MF-700
91-0911	16:15513	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009959	MF-706
91-100	16:14290	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007356	MF-940
91-1013	16:15829	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009969	MF-904
91-1043	16:14952	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009972	MF-404
91-1110	16:15130	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009974	
91-126	16:15986	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007389	MF-905
91-148	16:14291	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007392	MF-721
91-155	16:14292	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007393	MF-721
91-226	16:15858	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007467	MF-910
91-556	16:15443	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008589	MF-902
91-732	16:15344	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009939	MF-908
91-761	16:15550	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009940	MF-500
91-782	16:15437	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009941	
91-820	16:15987	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91009943	MF-700; MF-705
91-825	16:15241	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009944	MF-902
91-829	16:15353	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009946	MF-908
91-847	16:15242	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009947	MF-902
91-854	16:15817	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009948	MF-901
91-863	16:15781	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009949	MF-700; MF-705
91-884	16:14911	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009950	MF-704
91-887	16:14930	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009951	MF-904
91-892	16:14931	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009952	MF-904
91-893	16:15827	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009953	MF-904
91-896	16:15988	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009954	MF-908
91-902	16:15051	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009955	
91-903	16:15989	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009956	MF-905
91-905	16:15441	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009957	MF-708
91-907	16:14293	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009958	MF-706; MF-721
91-939	16:15828	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009960	MF-910

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
91-958	16:15514	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009962	MF-906
91-964	16:14932	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009963	MF-404
91-985	16:15947	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009965	MF-712
91-987	16:15551	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009966	MF-414
91-992	16:15990	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009967	MF-905
LAL–					
8969	16:15547	OSTI; NTIS (US Sales Only)		DE91767812	
9013	16:15548	OSTI; NTIS (US Sales Only)		DE91767806	
9014	16:15549	OSTI; NTIS (US Sales Only)		DE91767807	
9020	16:15468	OSTI; NTIS (US Sales Only)		DE91767823	
9039	16:15175	OSTI; NTIS (US Sales Only)		DE91767801	
9050	16:15096	OSTI; NTIS (US Sales Only)		DE91767811	
LAL-RT–					
9004	16:15498	OSTI; NTIS (US Sales Only)		DE91767808	
9011	16:15129	OSTI; NTIS (US Sales Only)		DE91767810	
LAMP–					
90/3	16:15499	OSTI; NTIS (US Sales Only); INIS		DE91623551	
LAO–					
2732-2020	16:15973	*See* EGG–10617-5083			
2732-2046	16:15972	*See* EGG–10617-5072			
LBL–					
26950	16:14812	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009328	MF-350
27311	16:15243	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010218	MF-241
27742	16:15244	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009330	MF-407; MF-350
28737-Rev.	16:14703	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010221	MF-201
29345	16:15131	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010210	PC-406
29357	16:15712	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009675	MF-413
29502	16:15750	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010222	MF-413
29595	16:14912	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010224	
29610	16:14813	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010273	MF-350
29678	16:14814	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010225	MF-920
29743	16:15948	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010206	PC-421
29748	16:14868	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010229	MF-350
29817	16:15445	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010230	MF-405
29817-Rev.1	16:15446	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010235	MF-405
29829	16:14671	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010231	MF-201
29878	16:14725	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010232	MF-350
29889	16:15751	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010205	PC-413
29898	16:15305	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010234	MF-403
29920	16:14983	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009732	MF-401
29925	16:14986	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010203	PC-203
30056	16:15818	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010204	PC-405
30057	16:15819	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009770	MF-406
30077	16:14411	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009071	MF-408
30095	16:15052	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009775	MF-413
30141	16:14739	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009325	MF-222
30170	16:14913	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009776	MF-404
30207	16:15176	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010245	MF-414
30220	16:14933	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009774	MF-404
30247	16:15552	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010238	MF-414
30254	16:14914	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009771	MF-404
90-Rev.-11/90	16:15522	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010209	PC-414
LBL-PUB–					
3083	16:15245	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009115	MF-350
680/3-91	16:15132	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009880	MF-414
682/12-90	16:15354	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009879	MF-408
685	16:15306	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009798	MF-400
LITH-IFM-R–					
182	16:15246	OSTI; NTIS (US Sales Only)		DE91763541	
LIYaF–					
1403	16:15177	OSTI; NTIS (US Sales Only); INIS		DE91625013	
1450	16:15178	OSTI; NTIS (US Sales Only); INIS		DE91625049	
1463	16:15201	OSTI; NTIS (US Sales Only); INIS		DE91625078	
1474	16:15500	OSTI; NTIS (US Sales Only); INIS		DE91623552	
1477	16:15752	OSTI; NTIS (US Sales Only); INIS		DE91623970	
1489	16:15501	OSTI; NTIS (US Sales Only); INIS		DE91623553	
1493	16:15179	OSTI; NTIS (US Sales Only); INIS		DE91626030	
1514	16:15595	OSTI; NTIS (US Sales Only); INIS		DE91625402	
1539	16:15753	OSTI; NTIS (US Sales Only); INIS		DE91623971	
1551	16:15754	OSTI; NTIS (US Sales Only); INIS		DE91623972	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
1557	16:15689	OSTI; NTIS (US Sales Only); INIS		DE91624117	
1565	16:15755	OSTI; NTIS (US Sales Only); INIS		DE91624066	
1567	16:15596	OSTI; NTIS (US Sales Only); INIS		DE91623915	
LMF–					
129	16:15428	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009419	PC-408; PC-407; PC-402
LU-TP–					
90-4	16:15597	OSTI; NTIS (US Sales Only); INIS		DE91625404	
90-7	16:15598	OSTI; NTIS (US Sales Only); INIS		DE91625405	
90-11	16:15599	OSTI; NTIS (US Sales Only); INIS		DE91625403	
90-13	16:15569	*See* DESY–90-144			
LUNFD6-NFFK–					
1002-SE	16:15685	OSTI; NTIS (US Sales Only); INIS		DE91625471	
LUTEDX-TEIE–					
5054-1-47-90	16:14654	OSTI; NTIS (US Sales Only)		DE91763548	
LUTFD2-TFRT–					
3206-1-75-90	16:15991	OSTI; NTIS (US Sales Only)		DE91763546	
5424-1-100-90	16:15033	OSTI; NTIS (US Sales Only)		DE91763547	
MF–					
122	16:15878	*See* DOE/ER/53223–158			
MHD-ITC–					
90-311	16:14749	*See* DOE/PC/90274–T9			
90-312	16:14750	*See* DOE/PC/90274–T10			
MISC–					
90132	16:14623	*See* DOE/ID–10298			
MLM–					
3679	16:15053	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008825	PC-706
3680	16:15180	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91010046	PC-706
3684	16:14349	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009445	MF-704
MLM-MU–					
91-63-0003	16:14726	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009975	MF-700
MT-CWR–					
091-005	16:14900	*See* DOE/ER/45308–4			
MTCI–					
26367-108	16:13949	*See* DOE/MC/26367–2958			
MUTAD–					
891101.	16:15185	*See* NIKHEF-K-DIGEL–1989-9			
NAL-TM–					
620	16:14877	OSTI; NTIS (US Sales Only)		DE91764223	
NAL-TR–					
1064T	16:14878	OSTI; NTIS (US Sales Only)		DE91764224	
1066	16:14871	OSTI; NTIS (US Sales Only)		DE91764225	
1067	16:14872	OSTI; NTIS (US Sales Only)		DE91764226	
NASA-TM–					
103694	16:14843	*See* DOE/NASA/50162–5			
NBI-HE–					
90-66	16:15637	OSTI; NTIS (US Sales Only); INIS		DE91623515	
90-69	16:15638	OSTI; NTIS (US Sales Only); INIS		DE91623516	
90-70	16:15639	OSTI; NTIS (US Sales Only); INIS		DE91623517	
90-71	16:15859	OSTI; NTIS (US Sales Only); INIS		DE91623496	
90-72	16:15860	OSTI; NTIS (US Sales Only); INIS		DE91623497	
90-73	16:15600	OSTI; NTIS (US Sales Only); INIS		DE91623883	
90-76	16:15861	OSTI; NTIS (US Sales Only); INIS		DE91623498	
NDP–					
036	16:15309	*See* ORNL/CDIAC–41			
NEI-DK–					
465	16:14740	OSTI; NTIS (US Sales Only); INIS		DE91624791	
495	16:14432	OSTI; NTIS (US Sales Only)		DE91763364	
496	16:14696	OSTI; NTIS (US Sales Only)		DE91763365	
497	16:14380	OSTI; NTIS (US Sales Only)		DE91763366	
498	16:14387	OSTI; NTIS (US Sales Only)		DE91763370	
499	16:14716	OSTI; NTIS (US Sales Only)		DE91763388	
500	16:14727	OSTI; NTIS (US Sales Only)		DE91763397	
501	16:14677	OSTI; NTIS (US Sales Only)		DE91763399	
502	16:14396	OSTI; NTIS (US Sales Only)		DE91763400	
503	16:14381	OSTI; NTIS (US Sales Only)		DE91763401	
504	16:14397	OSTI; NTIS (US Sales Only)		DE91763411	
505	16:14126	OSTI; NTIS (US Sales Only)		DE91763412	
507	16:14040	OSTI; NTIS (US Sales Only)		DE91763422	
509	16:14497	OSTI; NTIS (US Sales Only)		DE91763425	

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510	16:14041	OSTI; NTIS (US Sales Only)		DE91763426	
511	16:14471	OSTI; NTIS (US Sales Only)		DE91763428	
NEI-FI–					
128	16:14816	OSTI; NTIS (US Sales Only)		DE91763437	
129	16:14857	OSTI; NTIS (US Sales Only)		DE91763443	
130	16:14685	OSTI; NTIS (US Sales Only)		DE91763462	
NEI-NO–					
117	16:15480	OSTI; NTIS (US Sales Only); INIS		DE91624482	
119	16:15034	OSTI; NTIS (US Sales Only)		DE91763499	
NEI-SE–					
64	16:14817	OSTI; NTIS (US Sales Only)		DE91763542	
NIFS-DATA–					
8	16:15502	OSTI; NTIS (US Sales Only); INIS		DE91767978	
9	16:15673	OSTI; NTIS (US Sales Only); INIS		DE91767977	
NIFS-WS–					
2	16:15949	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009935	MF-423
NIIEFA-P-A–					
0795	16:15133	OSTI; NTIS (US Sales Only); INIS		DE91624882	
0817	16:15150	OSTI; NTIS (US Sales Only); INIS		DE91624939	
NIIEFA-P-V–					
0810	16:15097	OSTI; NTIS (US Sales Only); INIS		DE91624835	
NIIYaF-MGU–					
88-50-71	16:15640	OSTI; NTIS (US Sales Only); INIS		DE91623518	
89-14-91	16:15183	OSTI; NTIS (US Sales Only); INIS		DE91625050	
89-15-92	16:15820	OSTI; NTIS (US Sales Only); INIS		DE91623660	
89-32-109	16:15641	OSTI; NTIS (US Sales Only); INIS		DE91623519	
89-35-112	16:15469	OSTI; NTIS (US Sales Only); INIS		DE91623793	
89-36-113	16:15134	OSTI; NTIS (US Sales Only); INIS		DE91624883	
89-56-133	16:15553	OSTI; NTIS (US Sales Only); INIS		DE91623947	
89-8-85	16:15181	OSTI; NTIS (US Sales Only); INIS		DE91625051	
89-9-86	16:15182	OSTI; NTIS (US Sales Only); INIS		DE91625052	
NIKHEF-H–					
89-8	16:15642	OSTI; NTIS (US Sales Only); INIS		DE91623520	
90-10	16:15184	OSTI; NTIS (US Sales Only); INIS		DE91625032	
90-14	16:15643	OSTI; NTIS (US Sales Only); INIS		DE91623521	
90-16	16:15554	OSTI; NTIS (US Sales Only); INIS		DE91623941	
90-19	16:15601	OSTI; NTIS (US Sales Only); INIS		DE91623896	
90-20	16:15602	OSTI; NTIS (US Sales Only); INIS		DE91625382	
90-22	16:15603	OSTI; NTIS (US Sales Only); INIS		DE91625397	
90-23	16:15604	OSTI; NTIS (US Sales Only); INIS		DE91625383	
91-03	16:15862	OSTI; NTIS (US Sales Only); INIS		DE91625211	
NIKHEF-K-DIGEL–					
1989-9	16:15185	OSTI; NTIS (US Sales Only); INIS		DE91626041	
1990	16:15186	OSTI; NTIS (US Sales Only); INIS		DE91625014	
1990-3	16:15187	OSTI; NTIS (US Sales Only); INIS		DE91625015	
1990-4	16:15188	OSTI; NTIS (US Sales Only); INIS		DE91625016	
NIKHEF-K-LINO–					
1989-6	16:15098	OSTI; NTIS (US Sales Only); INIS		DE91625882	
NIPER–					
466	16:14061	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002224	PC-122
507	16:14062	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002227	PC-122
NIVA-O–					
89210	16:15307	OSTI; NTIS (US Sales Only)		DE91763502	
NMP-RMT–					
900326	16:15308	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009372	MF-702
NORDITA–					
90/60-A(prepr.)	16:15470	OSTI; NTIS (US Sales Only); INIS		DE91623833	
90/64-AP(prepr.)	16:15471	OSTI; NTIS (US Sales Only); INIS		DE91623850	
90/65-A(prepr.)	16:15472	OSTI; NTIS (US Sales Only); INIS		DE91623797	
90/66-A(prepr.)	16:15473	OSTI; NTIS (US Sales Only); INIS		DE91623798	
90/67-A(prepr.)	16:15474	OSTI; NTIS (US Sales Only); INIS		DE91623799	
90/68-AP(prepr.)	16:15475	OSTI; NTIS (US Sales Only); INIS		DE91623800	
90/73-A(prepr.)	16:15476	OSTI; NTIS (US Sales Only); INIS		DE91623834	
NRC–					
10-No.5	16:14549	OSTI; NTIS; INIS; GPO		TI91010176	
11-Index-1	16:14550	OSTI; NTIS; INIS; GPO		TI91010165	
11-No.3	16:14551	OSTI; NTIS; INIS; GPO		TI91010167	
11-No.4	16:14552	OSTI; NTIS; INIS; GPO		TI91010166	
11-No.6	16:14553	OSTI; NTIS; INIS; GPO		TI91010168	
12-No.1R	16:14554	OSTI; NTIS; INIS; GPO		TI91010169	
5-INDEX-1	16:14544	OSTI; NTIS; INIS; GPO		TI91010170	

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NRC–					
5-No.1	16:14545	OSTI; NTIS; INIS; GPO		TI91010173	
5-No.2	16:14546	OSTI; NTIS; INIS; GPO		TI91010177	
5-No.3	16:14547	OSTI; NTIS; INIS; GPO		TI91010174	
6-No.3	16:14548	OSTI; NTIS; INIS; GPO		TI91010175	
NRCI–					
76/12	16:14555	OSTI; NTIS; INIS; GPO		TI91010172	
76/Index-3	16:14556	OSTI; NTIS; INIS; GPO		TI91010171	
NRRI–					
90-15	16:14741	OSTI; National Regulatory Research Inst., 1080 Carmack Rd., Columbus, OH 43210		TI91009683	
NSF-ITP–					
90-172	16:15573	*See* DOE/ER/40423–13-P90			
90-214	16:15559	*See* BNL–45575			
NSS-R–					
146	16:14295	OSTI; NTIS (US Sales Only); INIS		DE91625106	
NSS/G–					
113	16:14294	OSTI; NTIS (US Sales Only); INIS		DE91624469	
NSS/R–					
147	16:14296	OSTI; NTIS (US Sales Only); INIS		DE91625107	
159	16:14297	OSTI; NTIS (US Sales Only); INIS		DE91625108	
184	16:14298	OSTI; NTIS (US Sales Only); INIS		DE91625109	
206	16:15273	OSTI; NTIS (US Sales Only); INIS		DE91624427	
216	16:15274	OSTI; NTIS (US Sales Only); INIS		DE91624429	
224	16:15275	OSTI; NTIS (US Sales Only); INIS		DE91624430	
NTISUB/B–					
142-76/012	16:14555	*See* NRCI–76/12			
142-76/403	16:14556	*See* NRCI–76/Index-3			
142-77/001	16:14545	*See* NRC–5-No.1			
142-77/002	16:14546	*See* NRC–5-No.2			
NTISUB/C–					
142-77/003	16:14547	*See* NRC–5-No.3			
142/009	16:14548	*See* NRC–6-No.3			
142/401	16:14544	*See* NRC–5-INDEX-1			
NTISUB/E–					
142/011	16:14549	*See* NRC–10-No.5			
NUREG–					
0040-Vol.14-No.4	16:14557	OSTI; NTIS; INIS; GPO		TI91009036	
0304-Vol.15-No.4	16:14558	OSTI; NTIS; INIS; GPO		TI91010004	
0430-Vol.10	16:14350	OSTI; NTIS; INIS; GPO		TI91009800	
0540-Vol.13-No.1	16:14559	OSTI; NTIS; INIS; GPO		TI91009410	
0750-Vol.21-No.2	16:14560	OSTI; NTIS; INIS; GPO		TI91010164	
0750-Vol.32-Index2	16:14561	OSTI; NTIS; INIS; GPO		TI91010369	
0750-Vol.33-No.1	16:14562	OSTI; NTIS; INIS; GPO		TI91009621	
0940-Vol.9-No.4	16:14563	OSTI; NTIS; INIS; GPO		TI91008492	
NUREG/CP–					
0116-Vol.1	16:14641	OSTI; NTIS; INIS; GPO		TI91009644	MF-902; MF-907
0116-Vol.2	16:14818	OSTI; NTIS; INIS; GPO		TI91009673	MF-902; MF-907
NUREG/CR–					
2000-Vol.10-No.1	16:14564	OSTI; NTIS; INIS; GPO		TI91009076	
2000-Vol.10-No.2	16:14565	OSTI; NTIS; INIS; GPO		TI91010326	
3916	16:14642	OSTI; NTIS; INIS; GPO		TI91009409	
5139	16:14643	OSTI; NTIS; INIS; GPO		TI91009622	
5282	16:14644	OSTI; NTIS; INIS; GPO		TI91009157	
5285	16:14524	OSTI; NTIS; INIS; GPO		TI91009412	
5309	16:14645	OSTI; NTIS; INIS; GPO		TI91009411	
5555	16:14589	OSTI; NTIS; INIS; GPO		TI91010003	
5619	16:14579	OSTI; NTIS; INIS; GPO		TI91008929	
5656	16:15247	OSTI; NTIS; INIS; GPO		TI91009645	
5658	16:14646	OSTI; NTIS; INIS; GPO		TI91009623	
NVR–					
1.3	16:15802	OSTI; NTIS (US Sales Only); INIS		DE91624638	
NVS-P–					
11	16:14299	OSTI; NTIS (US Sales Only); INIS		DE91625090	
NYSERDA–					
88-17	16:14869	OSTI; New York State Energy Development Authority, Two Rockefeller Plaza, Albany, NY 12223		TI91009892	
88-18	16:14870	OSTI; New York State Energy Development Authority, Two Rockefeller Plaza, Albany, NY 12223		TI91009893	

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OCS/MMS–					
90-0072	16:14055	OSTI; Office of Offshore Information and Publications, Minerals Management Service, Mail Stop 4610, 381 Elden Street, Herndon, VA 22070-4817		TI91009065	
90-0095	16:14094	OSTI; Environmental Studies Branch (MS-4310), Minerals Management Service, 381 Elden Street, Herndon, VA 22070		TI91009823	
OITS–					
448	16:15572	*See* DOE/ER/40224–158			
ORNL–					
6600	16:14705	OSTI; NTIS; GPO Dep.	E 1.99:	DE91000542	
6656	16:14363	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010493	MF-400
ORNL/CCIP–					
91/03	16:15830	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009921	MF-414
ORNL/CDIAC–					
41	16:15309	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010436	MF-402
ORNL/FEDC–					
90/3	16:15950	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010485	PC-423; PC-424
ORNL/FTR–					
3870	16:15555	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009876	MF-414
3873	16:14229	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009783	MF-600
3874	16:15382	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009642	MF-408
3875	16:15503	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91010030	MF-411
3876	16:15504	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010241	MF-413
3879	16:15674	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010242	MF-413
3881	16:15189	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91010565	MF-414
3890	16:15248	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010459	MF-350
ORNL/M–					
1410	16:14819	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010240	MF-350
ORNL/NSIC–					
200-Vol.10-No.1	16:14564	*See* NUREG/CR–2000-Vol.10-No.1			
200-Vol.10-No.2	16:14565	*See* NUREG/CR–2000-Vol.10-No.2			
ORNL/RASA–					
90/2	16:14340	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009509	MF-511
ORNL/Sub–					
86-24610/1	16:14820	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010442	MF-350
ORNL/TM–					
11360	16:15322	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010445	MF-902
11479	16:15442	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91010446	
11545	16:15911	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010487	PC-426
11569	16:15276	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010447	MF-402
11648	16:14836	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009743	MF-700
11649	16:15249	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91010448	
11690	16:15207	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91010684	
11701	16:15912	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010488	PC-427
11718	16:15009	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010450	MF-406
11733	16:15010	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010452	MF-406
11747	16:15250	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010453	MF-402
11756	16:15913	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010489	PC-426
11758	16:15914	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010490	PC-426
11780	16:14300	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009632	MF-407
11786	16:15992	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010215	MF-405
11812	16:15756	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010454	MF-413
1391	16:14821	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010380	MF-350
ORNL/TR–					
91/4	16:15135	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010722	MF-414
ORS–					
1987-1	16:14301	OSTI; NTIS (US Sales Only); INIS		DE91626127	
OUP–					
90-26	16:15605	OSTI; NTIS (US Sales Only); INIS		DE91623384	
90-28	16:15690	OSTI; NTIS (US Sales Only); INIS		DE91625472	
90-29	16:15644	OSTI; NTIS (US Sales Only); INIS		DE91623522	
90-30	16:15821	OSTI; NTIS (US Sales Only); INIS		DE91623615	
90-31	16:15645	OSTI; NTIS (US Sales Only); INIS		DE91623523	
90-32	16:15606	OSTI; NTIS (US Sales Only); INIS		DE91623885	
90-33	16:15915	OSTI; NTIS (US Sales Only); INIS		DE91623717	
90-34	16:15646	OSTI; NTIS (US Sales Only); INIS		DE91623524	
91-05	16:15757	OSTI; NTIS (US Sales Only); INIS		DE91624431	

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
OY/PSTL–					
C77	16:14375	OSTI; NTIS (US Sales Only)		DE91763442	
PARAMETER/IE–					
176	16:14524	*See* NUREG/CR–5285			
200	16:14645	*See* NUREG/CR–5309			
PATENTS-					
	16:13946	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14057	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14058	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14059	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14063	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14064	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14065	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14066	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14067	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14068	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14069	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14070	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14071	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14072	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14073	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14074	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
	16:14075	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14076	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14077	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14078	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14079	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14080	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14081	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14082	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14083	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14084	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14085	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14086	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14088	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14098	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14099	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14103	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14122	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14123	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
	16:14132	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14133	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14136	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14423	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14424	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14425	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14488	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14660	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14661	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14662	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14663	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14664	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14666	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14667	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14672	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14673	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14674	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14675	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
	16:14676	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14782	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14832	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14833	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14834	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14835	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14862	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14863	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14864	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14865	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14879	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14880	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14881	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14884	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14885	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14886	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14936	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14958	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
	16:14959	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:14960	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15018	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15019	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15020	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15021	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15039	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15041	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15042	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15043	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15044	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15046	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15047	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15067	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15068	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15069	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15070	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
	16:15195	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
	16:15196	Micromedia Ltd., Technical Information Centre, 165 Hotel de Ville, Place du Portage, Phase 2, Hull, Quebec, Canada J8X 3X2. Prices: PC $4.00 CAN; MF $2.75 CAN			
PB–					
80-914/202-11-Index-1	16:14550	*See* NRC–11-Index-1			
80-914202-11-No.3	16:14551	*See* NRC–11-No.3			
80-914202-11-No.6	16:14553	*See* NRC–11-No.6			
80-914204-11-No.4	16:14552	*See* NRC–11-No.4			
80-914207-12-No.1R	16:14554	*See* NRC–12-No.1R			
PCCF-RI–					
9007	16:15758	OSTI; NTIS (US Sales Only)		DE91767805	
PFC/RR–					
91-1	16:15929	*See* DOE/ET/51013–T239			
91-3	16:15928	*See* DOE/ET/51013–T238			
91-4	16:15886	*See* DOE/ET/51013–291			
PINSTECH/NMD–					
121	16:15822	OSTI; NTIS (US Sales Only); INIS		DE91623616	
PINSTECH/NPD–					
126	16:14915	OSTI; NTIS (US Sales Only); INIS		DE91624373	
127	16:14984	OSTI; NTIS (US Sales Only); INIS		DE91624220	
128	16:14916	OSTI; NTIS (US Sales Only); INIS		DE91625635	
PINSTECH/RIAD–					
122	16:15323	OSTI; NTIS (US Sales Only); INIS		DE91624470	
PNL–					
6450-40-HEDR	16:15251	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009408	MF-707
6659	16:14822	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009156	MF-350
6778-Vol.1	16:14823	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009744	MF-350
6778-Vol.2	16:14824	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009821	MF-350
6964-HEDR	16:14324	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009778	MF-707
7223-HEDR	16:14647	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009815	MF-707
7253-HEDR	16:14341	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009780	MF-707
7340-HEDR	16:15252	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009779	MF-707
7423-HEDR	16:14342	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009781	MF-707
7510	16:15247	*See* NUREG/CR–5656			
7513	16:14646	*See* NUREG/CR–5658			
7519	16:14825	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008428	MF-363
7520	16:14302	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009680	MF-940
7562	16:14303	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009730	MF-702
7595	16:14304	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009369	MF-940
7598	16:14305	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009370	MF-940
7629	16:14987	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008427	MF-313
7636	16:14648	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009682	MF-607
7642	16:14697	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009731	MF-630
7647	16:14698	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010014	
7652	16:14719	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009643	MF-350
7659	16:14826	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009681	MF-350
7670	16:15253	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010567	MF-408
PNL-SA–					
17139	16:15190	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010754	MF-606
18573	16:14934	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009055	MF-404
18907	16:15429	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010028	MF-407
18927	16:15430	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009145	MF-408
18965	16:15438	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010010	MF-502
19189	16:15993	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009126	MF-700
19276	16:15324	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010008	MF-510
POEF-T–					
3544	16:14343	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009508	MF-517
PPPL–					
2736	16:15916	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010042	PC-420; PC-426
2737	16:15917	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010725	PC-420; PC-427
2738	16:15918	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010043	PC-420; PC-426; PC-427
2740	16:15919	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91011007	PC-420; PC-426
2742	16:15481	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91011104	PC-427
2748	16:15505	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009849	PC-426

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
PSI-FR–					
1526	16:14842	*See* DOE/ID/12882–1			
PSI-PR–					
90-08.	16:15106	*See* CERN–90-02			
RAL–					
89-136	16:15506	OSTI; NTIS (US Sales Only); INIS		DE91623574	
90-073	16:15482	OSTI; NTIS (US Sales Only); INIS		DE91624483	
90-079	16:15607	OSTI; NTIS (US Sales Only); INIS		DE91623886	
90-080	16:15608	OSTI; NTIS (US Sales Only); INIS		DE91623887	
90-081	16:15507	OSTI; NTIS (US Sales Only); INIS		DE91623575	
90-082	16:15920	OSTI; NTIS (US Sales Only); INIS		DE91623704	
90-086	16:15647	OSTI; NTIS (US Sales Only); INIS		DE91623525	
90-088	16:15191	OSTI; NTIS (US Sales Only); INIS		DE91625033	
RERF-TR–					
6-90	16:15431	OSTI; NTIS (US Sales Only); INIS		DE91768051	
RFP–					
4348	16:15439	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010415	MF-702
RISO-M–					
2842	16:15254	OSTI; NTIS (US Sales Only)		DE91763374	
2843	16:15277	OSTI; NTIS (US Sales Only)		DE91763375	
2851	16:14985	OSTI; NTIS (US Sales Only); INIS		DE91624221	
2861	16:14472	OSTI; NTIS (US Sales Only)		DE91763376	
2875	16:14325	OSTI; NTIS (US Sales Only); INIS		DE91624627	
2876	16:14216	OSTI; NTIS (US Sales Only); INIS		DE91624284	
2878	16:15200	OSTI; NTIS (US Sales Only)		DE91763377	
2884	16:14473	OSTI; NTIS (US Sales Only)		DE91763378	
2887	16:14474	OSTI; NTIS (US Sales Only)		DE91763386	
2888	16:14917	OSTI; NTIS (US Sales Only); INIS		DE91624293	
2892	16:14503	OSTI; NTIS (US Sales Only); INIS		DE91624974	
2894	16:14475	OSTI; NTIS (US Sales Only)		DE91763379	
2897	16:15192	OSTI; NTIS (US Sales Only); INIS		DE91625017	
2902	16:14476	OSTI; NTIS (US Sales Only)		DE91763387	
2907	16:14042	OSTI; NTIS (US Sales Only)		DE91763380	
2920	16:14721	OSTI; NTIS (US Sales Only)		DE91763381	
2921	16:14706	OSTI; NTIS (US Sales Only)		DE91763382	
RISO-R–					
579	16:15963	OSTI; NTIS (US Sales Only); INIS		DE91625180	
Risley-Trans–					
5972	16:14572	OSTI; NTIS (US Sales Only); INIS		DE91625116	
SAND–					
84-1531	16:14642	*See* NUREG/CR–3916			
87-2381	16:14306	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009820	MF-814
88-7114	16:15045	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009097	MF-253
88-7115	16:14458	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009854	MF-253
89-0592	16:14307	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010651	MF-814
89-1585	16:14308	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009985	MF-721
89-1786	16:14649	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009187	MF-520
89-1929	16:15951	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010719	PC-420; PC-421; PC-422; PC-423;
89-2270	16:14309	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009184	MF-814
90-0365	16:14310	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009725	MF-812
90-0945	16:15202	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009726	MF-706
90-1018	16:14953	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009616	MF-704
90-1074C	16:14056	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009173	MF-122
90-1344	16:14459	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009098	MF-253
90-1712C	16:15054	OSTI; NTIS; GPO Dep.	E 1.99:	DE90013196	MF-528
90-1745C	16:15055	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009982	MF-706
90-1850C	16:15515	OSTI; NTIS; GPO Dep.	E 1.99:	DE91005240	MF-706
90-2121	16:14579	*See* NUREG/CR–5619			
90-2164C	16:14412	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010577	MF-275
90-2178C	16:15208	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009764	MF-700
90-2231C	16:15994	OSTI; NTIS; GPO Dep.	E 1.99:	DE90017029	MF-706
90-2357C	16:15952	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010476	MF-704
90-2513	16:16024	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009727	MF-700
90-2541C	16:15516	OSTI; NTIS; GPO Dep.	E 1.99:	DE91005310	MF-706
90-2564	16:15209	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91009728	MF-700
90-2572	16:14230	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009729	MF-820
90-2641C	16:15011	OSTI; NTIS; GPO Dep.	E 1.99:	DE91004789	MF-700

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
90-2780C	16:15056	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010585	MF-706
90-2827	16:14344	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010019	MF-630
90-2838C	16:14699	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009888	MF-702
90-2883C	16:15081	OSTI; NTIS; GPO Dep.	E 1.99:	DE91004723	MF-700
90-2900C	16:15057	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010579	MF-706
90-3049C	16:14954	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009257	MF-704
90-3064C	16:15012	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008175	MF-722
90-3065C	16:14311	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91008573	MF-820; MF-940
90-3129C	16:14955	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009255	MF-704
90-3182	16:15013	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009545	MF-705
90-3189C	16:15058	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009250	MF-706
90-3192	16:14345	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010018	MF-630
90-3227C	16:15517	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007066	MF-706
91-0043C	16:15953	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91010584	MF-712
91-0381C	16:15059	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009763	MF-706
91-0444C	16:15255	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009252	MF-706
91-0445C	16:15060	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009039	MF-706
91-0454C	16:15256	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008255	MF-700
91-0476C	16:15325	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009168	MF-702
91-0499C	16:14918	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009544	MF-704
91-0531C	16:15210	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009166	MF-706
91-0560C	16:15061	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009254	MF-706
91-0570C	16:14434	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009253	MF-236
91-0582C	16:14427	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009251	MF-236
91-0586C	16:14956	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009474	MF-704
91-0649C	16:15014	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010480	MF-706
91-0650C	16:15015	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010479	MF-706
SERC-UCFB–					
90-0029	16:14407	*See* STEV-SOL–91-2			
SERI/TP–					
214-4141	16:14418	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002132	MF-271
231-3996	16:14382	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002125	MF-241
253-4124	16:14827	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002131	MF-369
SIEMENS-KWU-TW–					
1187/89	16:14919	OSTI; NTIS (US Sales Only); INIS		DE91764551	
SIS–					
1990:8	16:15803	OSTI; NTIS (US Sales Only); INIS		DE91624665	
SKB-TR–					
90-08	16:14992	OSTI; NTIS (US Sales Only); INIS		DE91624275	
90-25	16:14993	OSTI; NTIS (US Sales Only); INIS		DE91624276	
90-26	16:15432	OSTI; NTIS (US Sales Only); INIS		DE91625741	
90-27	16:15326	OSTI; NTIS (US Sales Only); INIS		DE91625728	
90-28	16:14969	OSTI; NTIS (US Sales Only); INIS		DE91625521	
90-29	16:15327	OSTI; NTIS (US Sales Only); INIS		DE91625729	
90-30	16:15447	OSTI; NTIS (US Sales Only); INIS		DE91624447	
SL–					
1251-87126-Vol.1	16:14477	OSTI; NTIS (US Sales Only)		DE91763429	
1251-87126-Vol.2	16:14478	OSTI; NTIS (US Sales Only)		DE91763430	
1251-87126-Vol.3	16:14479	OSTI; NTIS (US Sales Only)		DE91763431	
SLAC-PUB–					
4561-Rev.	16:15995	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010289	MF-414
5348.	16:15554	*See* NIKHEF-H–90-16			
5450	16:16025	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010290	MF-414
SLU-LBT-S–					
4	16:14393	*See* STEV-EO–91-2			
SNV–					
3700	16:15257	OSTI; NTIS (US Sales Only)		DE91763506	
3712	16:14728	OSTI; NTIS (US Sales Only)		DE91763540	
3718	16:15258	OSTI; NTIS (US Sales Only)		DE91763539	
3750	16:14700	OSTI; NTIS (US Sales Only)		DE91763538	
3784	16:15328	OSTI; NTIS (US Sales Only)		DE91763505	
SR/NES–					
90-01	16:14701	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91009199	MF-950
90-03	16:14742	OSTI; NTIS; INIS; GPO; GPO Dep.	E 1.99:	DE91009201	MF-950
90-05	16:14105	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91009203	MF-950
90-06	16:14129	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91009204	MF-950
90-07	16:14048	OSTI; NTIS; GPO; GPO Dep.	E 1.99:	DE91009205	MF-950
SSC-SDC–					
90-00099	16:15552	*See* LBL–30247			

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SSCL–					
308	16:15099	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91011002	PC-414
320	16:15136	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009984	PC-414
343	16:15137	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91011004	PC-414
347	16:15556	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009903	PC-400
371	16:15082	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91011003	PC-414
372	16:15138	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010315	PC-414
373	16:15609	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91011001	PC-414
374	16:15139	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010016	PC-414
STEV-AVF–					
90-2	16:14383	OSTI; NTIS (US Sales Only)		DE91763509	
STEV-EO–					
91-1	16:14376	OSTI; NTIS (US Sales Only)		DE91763559	
91-2	16:14393	OSTI; NTIS (US Sales Only)		DE91763560	
STEV-FBT–					
90-8	16:15259	OSTI; NTIS (US Sales Only)		DE91763507	
90-10	16:15260	OSTI; NTIS, US Sales Only		DE91763508	
91-2	16:15261	OSTI; NTIS (US Sales Only)		DE91763551	
91-3	16:14043	OSTI; NTIS (US Sales Only)		DE91763552	
91-4	16:15262	OSTI; NTIS (US Sales Only)		DE91763553	
STEV-FGT–					
91-1	16:14384	OSTI; NTIS (US Sales Only)		DE91763554	
STEV-SOL–					
91-2	16:14407	OSTI; NTIS (US Sales Only)		DE91763555	
STEV-TORV–					
90-12	16:13945	OSTI; NTIS (US Sales Only)		DE91763510	
90-13	16:14024	OSTI; NTIS (US Sales Only)		DE91763511	
91-1	16:13934	OSTI; NTIS (US Sales Only)		DE91763556	
STEV-VP–					
91-1	16:14828	OSTI; NTIS (US Sales Only)		DE91763557	
91-2	16:14829	OSTI; NTIS (US Sales Only)		DE91763558	
STF–					
11A90014	16:14858	OSTI; NTIS (US Sales Only)		DE91763504	
21A90050	16:14095	OSTI; NTIS (US Sales Only)		DE91763498	
STRIPA-TR–					
90-08	16:15448	OSTI; NTIS (US Sales Only); INIS		DE91624448	
90-09	16:15449	OSTI; NTIS (US Sales Only); INIS		DE91624449	
90-16	16:15450	OSTI; NTIS (US Sales Only); INIS		DE91624450	
STUDSVIK-ED–					
89-35	16:14131	*See* SVF–374			
89-42	16:14828	*See* STEV-VP–91-1			
90-27	16:14829	*See* STEV-VP–91-2			
STUDSVIK-EP–					
90-16	16:14384	*See* STEV-FGT–91-1			
90-25	16:15262	*See* STEV-FBT–91-4			
STUDSVIK-NS–					
90-73	16:14043	*See* STEV-FBT–91-3			
SV-UB–					
90-40	16:14392	OSTI; NTIS (US Sales Only)		DE91763550	
90-43	16:14391	OSTI; NTIS (US Sales Only)		DE91763512	
SV-UG–					
90-45	16:14106	OSTI; NTIS (US Sales Only)		DE91763515	
90-46	16:14107	OSTI; NTIS (US Sales Only)		DE91763516	
90-47	16:14108	OSTI; NTIS (US Sales Only)		DE91763517	
90-48	16:14109	OSTI; NTIS (US Sales Only)		DE91763518	
90-49	16:14110	OSTI; NTIS (US Sales Only)		DE91763519	
90-50	16:14111	OSTI; NTIS (US Sales Only)		DE91763520	
90-51	16:14112	OSTI; NTIS (US Sales Only)		DE91763521	
90-52	16:14113	OSTI; NTIS (US Sales Only)		DE91763522	
90-53	16:14114	OSTI; NTIS (US Sales Only)		DE91763523	
90-54	16:14115	OSTI; NTIS (US Sales Only)		DE91763524	
90-55	16:14116	OSTI; NTIS (US Sales Only)		DE91763525	
90-56	16:14117	OSTI; NTIS (US Sales Only)		DE91763526	
90-57	16:14118	OSTI; NTIS (US Sales Only)		DE91763527	
90-58	16:14119	OSTI; NTIS (US Sales Only)		DE91763528	
90-59	16:14120	OSTI; NTIS (US Sales Only)		DE91763529	
90-61	16:14121	OSTI; NTIS (US Sales Only)		DE91763530	
90-63	16:14887	OSTI; NTIS (US Sales Only)		DE91763514	
SV-US–					
90-60	16:14745	OSTI; NTIS (US Sales Only)		DE91763513	

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SVF-					
374	16:14131	OSTI; NTIS (US Sales Only)		DE91763531	
381	16:14135	OSTI; NTIS (US Sales Only)		DE91763532	
382	16:14678	OSTI; NTIS (US Sales Only)		DE91763533	
383	16:14859	OSTI; NTIS (US Sales Only)		DE91763534	
TAUP-					
1836-90	16:15615	*See* DESY-90-126			
TECHNION-PH-					
90-26	16:15564	*See* DESY-90-125			
TR-					
7020-009-91	16:14841	*See* DOE/ID/12826-1			
82/12	16:14517	*See* DOE/NE/34082-T51			
82/13	16:14506	*See* DOE/NE/34082-T22			
84/25A	16:14508	*See* DOE/NE/34082-T29			
84/28	16:14505	*See* DOE/NE/34082-T16			
84/29	16:14511	*See* DOE/NE/34082-T38			
84/31	16:14510	*See* DOE/NE/34082-T37			
86/52	16:14507	*See* DOE/NE/34082-T23			
86/53	16:14516	*See* DOE/NE/34082-T50			
87/56	16:14509	*See* DOE/NE/34082-T36			
87/57	16:14514	*See* DOE/NE/34082-T48			
87/58	16:14515	*See* DOE/NE/34082-T49			
87/65	16:14512	*See* DOE/NE/34082-T40			
88/70	16:14513	*See* DOE/NE/34082-T47			
TRITA-KUT-					
1051	16:15329	OSTI; NTIS (US Sales Only)		DE91763549	
TTC-					
1037	16:15012	*See* SAND-90-3064C			
UCID-					
16986-90-3/4	16:14167	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009722	MF-123
18987-91	16:15682	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010909	MF-413
21640	16:14312	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009723	MF-814
UCRL-					
15964	16:14313	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009760	MF-814
53946	16:15759	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010045	PC-701; PC-705
UCRL-CR-					
105634	16:14889	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010255	MF-700
105944	16:15203	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009765	MF-706
106146	16:14920	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008567	MF-704
106596	16:15218	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009772	MF-706
106704	16:15211	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009777	
UCRL-ID-					
106201	16:15036	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009718	MF-706
106311	16:15193	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009719	MF-707
106421	16:15212	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91009720	MF-741
106556	16:15037	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009721	MF-706; MF-702
106591	16:15508	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010122	MF-700
106599	16:15278	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010121	
106618	16:15518	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010120	MF-700
106621	16:15996	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010430	MF-705
106827	16:15016	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010123	MF-706
106965	16:15997	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010907	MF-405
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104036	16:15998	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009751	MF-405
104404	16:15062	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010467	MF-713
104531	16:14314	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009625	MF-814
104650	16:15063	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009758	MF-700
104981-Rev.1	16:15954	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91010464	MF-712
105011	16:15263	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010155	MF-700
105106	16:14957	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009749	MF-712
105120	16:15064	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008730	MF-706
105182	16:15519	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002792	MF-405
105183	16:15520	OSTI; NTIS; GPO Dep.	E 1.99:	DE91002790	MF-405
105185	16:15999	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007123	MF-705
105271	16:15264	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009757	MF-702
105277	16:15265	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009476	MF-700
105285	16:15065	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010460	MF-500
105286	16:15066	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010468	MF-500
105376	16:14935	OSTI; NTIS; GPO Dep.	E 1.99:	DE91008568	MF-706

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105642	16:15477	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007623	MF-700
105643	16:15478	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007622	MF-700
105865	16:16026	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010465	MF-705
105885	16:14890	OSTI; NTIS; GPO Dep.	E 1.99:	DE91007148	MF-700
105920	16:15823	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010153	MF-712
106115	16:14044	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009734	MF-103
106476	16:15824	OSTI; NTIS (US Sales Only); GPO Dep.	E 1.99:	DE91010469	MF-712
106552	16:14921	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009756	
106617	16:16027	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010473	MF-705
106647	16:16001	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010156	MF-405
106798	16:15266	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010152	
106803	16:15140	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010474	MF-713
UCRL-LR-					
104684	16:15440	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010119	MF-707
UMN-TH-					
908/90	16:15460	*See* DOE/ER/40423-19			
UPTEC-					
90-110R	16:15964	OSTI; NTIS (US Sales Only); INIS		DE91626194	
USIP-					
90-03	16:15610	OSTI; NTIS (US Sales Only); INIS		DE91625406	
90-06	16:15194	OSTI; NTIS (US Sales Only); INIS		DE91626042	
UTHEP-					
90-1001.	16:15577	*See* IC-90/271			
UTK-					
91/01	16:15830	*See* ORNL/CCIP-91/03			
UTSI-					
89-08	16:14483	*See* DOE/ET/10815-139			
90-06	16:14748	*See* DOE/ET/10815-155			
UWFDM-					
850	16:15955	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009263	MF-712
UdeM-LPN-TH-					
34	16:15564	*See* DESY-90-125			
VAKOLA-TUTK-					
57	16:14860	OSTI; NTIS (US Sales Only)		DE91763444	
VTT-TIED-					
1135	16:14830	OSTI; NTIS (US Sales Only)		DE91763457	
1141	16:14584	OSTI; NTIS (US Sales Only); INIS		DE91624958	
1181	16:15267	OSTI; NTIS (US Sales Only)		DE91763452	
1184	16:14580	OSTI; NTIS (US Sales Only); INIS		DE91624951	
VTT-TUTK-					
669	16:15038	OSTI; NTIS (US Sales Only); INIS		DE91624943	
692	16:14487	OSTI; NTIS (US Sales Only)		DE91763456	
703	16:13982	OSTI; NTIS (US Sales Only)		DE91763451	
705	16:14831	OSTI; NTIS (US Sales Only)		DE91763453	
708	16:14581	OSTI; NTIS (US Sales Only); INIS		DE91624952	
710	16:14861	OSTI; NTIS (US Sales Only)		DE91763458	
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0393-Pt.2	16:14316	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009417	MF-902
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0988	16:14650	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007167	MF-520
0989	16:15330	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009421	MF-721
1006	16:16002	OSTI; NTIS; GPO Dep.	E 1.99:	DE91010112	MF-907
1007	16:14542	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010035	MF-520
1009	16:15017	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010032	MF-504
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1118	16:14317	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009362	MF-402
1119	16:14318	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009363	MF-402
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90-60-Vol.2	16:14327	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91010160	MF-702
WSRC-MS-					
90-192	16:14590	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91007231	MF-706
90-20	16:14651	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009340	MF-700
90-205	16:14652	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009323	MF-700

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90-266	16:14319	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009338	MF-721
91-026	16:14582	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009334	MF-706
WSRC-RP–					
89-820	16:14653	OSTI; NTIS; INIS; GPO Dep.	E 1.99:	DE91009300	MF-707
89-889	16:15295	*See* DOE/SR/18035–P-H2			
Y/DV–					
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91-YP507C/1-Pt.1	16:15331	OSTI; NTIS; GPO Dep.	E 1.99:	DE91009206	MF-702
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90-24	16:15648	OSTI; NTIS (US Sales Only); INIS		DE91768090	
90-25	16:15649	OSTI; NTIS (US Sales Only); INIS		DE91768089	
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89-19	16:15451	OSTI; NTIS (US Sales Only); INIS		DE91624451	

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DE91623912	ITEP–169-89
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DE91623972	LIYaF–1551
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DE91624089	IAEA-NDS–11(Rev.5)
DE91624090	IAEA-NDS–117(Rev.0)
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DE91624100	IAEA-NDS–92(Rev.0)
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DE91624104	ITEF–167-89
DE91624106	IAEA-NDS–86(Rev.0)
DE91624107	IAEA-NDS–87(Rev.2)
DE91624108	ITEF–117-89
DE91624109	ITEF–159-89
DE91624111	IAEA-NDS–88(Rev.2)
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DE91624127	IAEA-NDS–67(Rev.0)
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DE91624130	ITEP–151-89
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DE91624167	IAEA-NDS–13(Rev.5)
DE91624168	IAEA-NDS–62(Rev.0)
DE91624169	IAEA-NDS–91(Rev.0)
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DE91624293	RISO-M–2888
DE91624373	PINSTECH/NPD–126
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DE91624449	STRIPA-TR–90-09
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DE91624470	PINSTECH/RIAD–122
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DE91624483	RAL–90-073
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DE91624916	IFVE-OP–89-77
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DE91625119	IAEA-INFCIRC–389
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DE91625128	IAEA-NDS–100(Rev.3)
DE91625129	IAEA-NDS–107(Rev.4)
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UG Uganda
US United States of America (USA)
UY Uruguay

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